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J. ROBERT OPPENHEIMER
Physics in the Contemporary World

P. W. BRIDGMAN
Scientists and Social Responsibility

COMMENTS on Dr. Bridgman's Article by I. I. Rabi, Harold C. Urey, Lee A. DuBridge, W. F. Ogburn, Herbert Goldhamer, and Eugene Rabinowitch

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# PHYSICS IN THE CONTEMPORARY WORLD

*J. Robert Oppenheimer*

*Dr. Oppenheimer's authority to speak on the relation of physics to the contemporary scene derives from his years of experience as a teacher of physics, his leadership in the Manhattan Project and his current position as Director of the Institute for Advanced Study at Princeton. The following remarks formed the 1947 Arthur D. Little Memorial Lecture and are reprinted from THE TECHNOLOGY REVIEW, February, 1948, edited at the Massachusetts Institute of Technology.*

In the ways of science, its practice, the peculiarities of its discipline and universality, there are patterns which in the past have somewhat altered, and in the future may greatly alter, all that we think about the world and how we manage to live in it. What I shall be able to say of this will not be rich in exhortation; for this is ground that I know how to tread only very slightly.

But that I should be speaking of such general and such difficult questions at all reflects in the first instance a good deal of self-consciousness on the part of physicists. This self-consciousness is in part a result of the highly critical traditions which have grown up in physics in the last half century, where we have been forced to become aware of what it is that we are doing. It reflects also the experiences of this century, which have shown in so poignant a way how much the applications of science determine our welfare and that of our fellows, and which have cast in doubt that traditional optimism, that confidence in progress, which have characterized Western Culture since the Renaissance.

As it did on everything else, the last war had a great and at least a temporarily disastrous effect on the prosecution of pure science. The demands of military technology in this country and in Britain, the equally over-riding demands of the Resistance in much of Europe, distracted the physicists from their normal occupations as they distracted most other men.

We in this country, who take our wars rather spastically, perhaps witnessed a more total cessation of true professional activity in the field of physics, even in its training, than any other people. For in all the doings of war we, as a country, have been a little like the young physicist who went to Washington to work for the NDRC in 1940. There he met his first Civil Service questionnaire, and came to the questions on drinking—never, occasionally, habitually, to excess. He checked both "occasionally" and "to excess." So, in the past we have taken war.

All over the world, whether because of the closing of universities, or the distractions of scientists called in one way or another to serve their countries, or because of devastation and terror and attrition, there was a great gap in physical science. It has been an exciting and an inspiring sight to watch the recovery: a recovery testifying to extraordinary vitality and vigor in this human activity. Today, barely two years after the end of hostilities, physics is booming.

One may have gained the impression that this boom derives primarily from the application of the new techniques developed during the war, such as the atomic reactor and micro-wave equipment; one may have gained the impression that in large part the flourishing of physics lies in exploitation of the eagerness of governments to promote it. These are indeed important factors. But they are only a small part of the story. Without in any way deprecating the great value of wartime technology, one nevertheless sees how much of what is today new knowledge can trace its origin directly, by an orderly yet imaginative extension, to the kind of things that physicists were doing in their laboratories and with their pencils almost a decade ago.

Let me try to give a little more substance to the physics that is booming. We are continuing the attempt to discover, to identify and characterize, and surely ultimately to order, our knowledge of what the elementary particles of physics really are. I need hardly say that in the course of this we are learning again how far our notion of *elementarity*, of what makes a particle elementary, is from the early atomic ideas of the Hindu and Greek atomists, or even from the chemical atomists of a century ago. We are finding out that what we are forced to call elementary particles retain neither permanence nor identity, and they are elementary only in the sense that their properties cannot be understood by breaking them down into sub-components. Almost every month has surprises for us in the findings about these particles. We are meeting new ones for which we are not prepared. We are learning how poorly we had identified the properties even of our old friends among them. We are seeing what a challenging job the ordering of this experience is likely to be, and what a strange world we must enter to find that order.

## Tools for Understanding Elementary Particles

In penetrating into this world perhaps our sharpest tool in the past has been the observation of the phenomena of the cosmic rays in interaction with matter. But the next years will see an important methodological improvement, when the great program of ultra high energy accelerators begins to get under way. This program is itself one of the expensive parts of physics. It has been greatly subsidized by the Government, primarily through the Atomic Energy Commission and the Office of Naval Research. It is a superlative example, of which one could find so many, of the repayment that technology makes to basic science, in providing means whereby our physical experience can be extended and enriched.

Another progress is the refinement of our knowledge of the behavior of electrons within atomic systems, a refinement which on the one hand is based on the micro-wave techniques, to the developments of which the Radiation Laboratory of the Massachusetts Institute of Technology made unique contributions, and which on the other hand has provided a newly vigorous criterion for the adequacy of our knowledge of the interactions of radiation and matter. Thus we are beginning to see in this field at least a partial resolution, and I am myself inclined to think rather more than that, of the paradoxes that have plagued the professional physical theorists for two decades.

A third advance in atomic physics is in the increasing understanding of those forces which give to atomic nuclei their great stability, and to their transmutations their great violence. It is the prevailing view that a true understanding of these forces may well not be separable from the ordering of our experience with regard to elementary particles, and that it may also turn on an extension to new fields of recent advances in electro-dynamics.

However this may be, all of us who are physicists by profession know that we are embarked on another great adventure of exploration and understanding, and count ourselves happy for that.

## The International Picture

In how far is this an account of physics in the United States only? In how far does it apply to other parts of the world, more seriously ravaged and more deeply disturbed by the last war? That question may have a somewhat complex answer, to the varied elements of which one may pay respectful attention.

In much of Europe and in Japan, that part of physics which does not rest on the availability of elaborate and radical new equipment is enjoying a recovery comparable to our own. The traditional close associations of workers in various countries makes it just as difficult now to disentangle the contributions by nationality as it was in the past. But there can be little doubt that it is very much harder for a physicist in France, for instance, or the Low Countries, and very much more nearly impossible for him in Japan, to build a giant accelerator, than for the workers in this country.

Yet in those areas of the world where science has not merely been disturbed or arrested by war and by terror, but where terror and its official philosophy have, in a deep sense, corrupted its very foundations, even the traditional fraternity of scientists has not proved adequate protection against decay. It may not be clear to us in what way and to what extent the spirit of scientific inquiry may come to apply to matters not yet, and perhaps never to be, part of the domain of science; but that it does apply there is one very brutal indication. Tyranny, when it gets to be absolute, or when it tends so to become, finds it impossible to continue to live with science.

Even in the good ways of contemporary physics, we are reluctantly made aware of our dependence on things which lie outside our science. The experience of the war, for those who were called upon to serve the survival of their civilization through the Resistance, and for those who contributed more remotely, if far more decisively, by the development of new instruments and weapons of war, has left us with a legacy of concern. In these troubled times it is not likely that we shall be free of it altogether. Nor perhaps is it right that we should be.

Nowhere is this troubled sense of responsibility more acute, and surely nowhere has it been more prolix, than among those who participated in the development of atomic energy for military purposes. I should think that most historians would agree that other technical developments, notably radar, played a more decisive part in determining the outcome of this last war. But I doubt whether that participation would, of itself, have created the deep trouble and moral concern which so many of us who were physicists have felt, have voiced, and have tried to get over feeling. It is not hard to understand why this should be so. The physics which played the decisive part in the development of the atomic bomb came straight out of our laboratories and our journals.

Despite the vision and the farseeing wisdom of our wartime heads of state, the physicists felt a peculiarly intimate responsibility for suggesting, for supporting, and in the end, in large measure, for achieving, the realization of atomic weapons. Nor can we forget that these weapons, as they were in fact used, dramatized so mercilessly the inhumanity and evil of modern war. In some sort of crude sense which no vulgarity, no humor, no over-statement can quite extinguish, the physicists have known sin; and this is a knowledge which they cannot lose.

## The Interaction of Science and Technology

Probably in giving expression to such feelings of concern most of us have belabored the influence of science on society through the medium of technology. This is natural, since the developments of the war years were al-

most exclusively technological, and since the participation of academic scientists forced them to be deeply aware of an activity of whose existence they had always known but which had been often remote from them.

When I was a student at Göttingen twenty years ago, there was a story current about the great mathematician Hilbert, who perhaps would have liked, had the world let him, to have thought of his science as something independent of worldly vicissitudes. Hilbert had a colleague, an equally eminent mathematician, Felix Klein, who was certainly aware, if not of the dependence of science generally on society, at least of mathematics on the physical sciences which nourish it and give it application. Klein used to take some of his students to meet once a year with the engineers of the Technical High School in Hanover. One year he was ill, and asked Hilbert to go in his stead, and urged him, in the little talk that he would give, to try to refute the then prevalent notion that there was a basic hostility between science and technology. Hilbert promised to do so; but when the time came a magnificent absentmindedness led him instead to speak his own mind: "One hears a good deal nowadays of the hostility between science and technology. I don't think that is true, gentlemen. I am quite sure that it isn't true, gentlemen. It almost certainly isn't true. It really can't be true. *Sie haben ja gar nichts mit einander zu tun.* They have nothing whatever to do with one another." Today the wars and the troubled times deny us the luxury of such absentmindedness.

The great testimony of history shows how often in fact the development of science has emerged in response to technological, and even economic needs, and how in the economy of social effort, science, even of the most abstract and recondite kind, pays for itself again and again in providing the basis for radically new technological developments. In fact, most people, when they think of science as a good thing, when they think of it as worthy of encouragement, when they are willing to see their governments spend substance upon it, when they greatly do honor to men who in science have attained some eminence, have in mind that the conditions of their life have been altered just by such technology, of which they may be reluctant to be deprived.

The debt of science to technology is just as great. Even the most abstract researches owe their very existence to things that have taken place quite outside of science, and with the primary purpose of altering and improving the conditions of man's life. As long as there is a healthy physics, this mutual fructification will surely continue. Out of its work there will come in the future, as so often in the past, and with an apparently chaotic unpredictability, things which will improve man's health, ease his labor, and divert and edify him. There will come things which, properly handled, will shorten his working day and take away the most burdensome part of his effort, which will enable him to communicate, to travel, and to have a wider choice both in the general question of how he is to spend his life, and in the specific question of how he is to spend an hour of his leisure. There is no need to belabor this point, nor its obverse—that out of science there will come, as there has in this last war, a host of instruments of destruction which will facilitate that labor, even as they have facilitated all others.

## The Scientist Is Responsible to Science

But no scientist, no matter how aware he may be of these fruits of his science, cultivates his work, or refrains from it, because of arguments such as these. No scientist can hope to evaluate what his studies, his researches, his experiments, may in the end produce for his fellowmen, except in one respect—if they are sound, they will produce knowledge. And this deep complementarity between what may be conceived to be the social justification of science, and what is for the individual his compelling motive in its pursuit, makes us look for other answers to the question of the relation of science to society.

One of these is that the scientist should assume responsibility for the fruits of his work. I would not argue against this, but it must be clear to all of us how very modest such assumption of responsibility can be, how very ineffective it has been in the past, how necessarily ineffective it will surely be in the future. In fact, it appears little more than an exhortation to the man of learning to be properly uncomfortable; and, in the worst instances, is used as a sort of screen to justify the most casual, unscholarly and, in the last analysis, corrupt intrusion of scientists into other realms of which they have neither experience nor knowledge, nor the patience to obtain it.

The true responsibility of a scientist, as we all know, is to the integrity and vigor of his science. And because most scientists, like all men of learning, tend in part also to be teachers, they have a responsibility for the communication of the truths which they have found. This is at least a collective if not an individual responsibility. That we should see in this any insurance that the fruits of science will be used for man's benefit, or denied to man when they make for his distress or destruction, would be a tragic naiveté.

## Can Scientists' Ways Provide a Pattern?

There is another side of the coin. This is the question of whether there are elements in the way of life of the scientist which need not be restricted to the professional, and which have hope in them for bringing dignity and courage and serenity to other men. Science is not all of the life of reason; it is a part of it. As such, what can it mean to man?

Perhaps it would be well to emphasize that I am talking neither of wisdom, nor of an élite of scientists, but precisely of the kind of work and thought, of action and discipline, that makes up the everyday professional life of the scientist. It is not of any general insight into human affairs that I am talking. It is not the kind of thing we recognize in our greatest statesmen, after long service devoted to practical affairs and to the public interest. It is something very much more homely and robust than that. It has in it the kind of beauty that is inseparable from craftsmanship and form, but that has in it also the vigor which we rightly associate with the simple ordered lives of artisans or of farmers, that we rightly associate with lives to which limitations of scope, and traditional ways, have given robustness and structure.

Even less would it be right to interpret the question of what there is in the ways of science which may be of general value to mankind in terms of the creation of an élite. The study of physics, and I think my colleagues in the other sciences will let me speak for them too, does not make philosopher-kings. It has not, until now, made kings. It almost never makes fit philosophers—so rarely that they must be counted as exceptions. If the professional pursuit of science makes

good scientists, if it makes men with a certain serenity in their lives, who yield perhaps a little more slowly than others to the natural corruptions of their time, it is doing a great deal, and all that we may rightly ask of it. For if Plato believed that in the study of geometry, a man might prepare himself for wisdom and responsibility in the world of men, it was precisely because he thought so hopefully that the understanding of men could be patterned after the understanding of geometry. If we believe that today, it is in a much more recondite sense, and a much more cautious one.

What then is the point? For one thing it is to describe some of the features of the professional life of the scientist, which make it one of the great phenomena of the contemporary world. Here again, I would like to speak of physics; but I have enough friends in the other sciences to know how close their experience is to ours. And I know too that despite profound differences in method and technique, differences which surely are an appropriate reflection of the difference in the areas of the world under study, what I would say of physics will seem familiar to workers in other disparate fields, such as mathematics, or biology.

## The Nature of the Scientific Discipline

What are some of these points? There is, in the first instance, a total lack of authoritarianism, which is hard to comprehend or to admit unless one has lived with it. This is accomplished by one of the most exacting of intellectual disciplines. In physics the worker learns the possibility of error very early. He learns that there are ways to correct his mistakes; he learns the futility of trying to conceal them. For it is not a field in which error awaits death and subsequent generations for verdict—the next issue of the journals will take care of it. The refinement of techniques for the prompt discovery of error serves as well as any other as a hallmark of what we mean by science.

In any case, it is an area of collective effort, in which there is a clear and well defined community whose canons of taste and order simplify the life of the practitioner. It is a field in which the technique of experiment has given an almost perfect harmony to the balance between thought and action. In it we learn so frequently that we could almost become accustomed to it, how vast is the novelty of the world, and how much even the physical world transcends in delicacy and in balance the limits of man's prior imaginings. We learn that views may be useful and inspiriting although they are not complete. We come to have a great caution in all assertions of totality, of finality or absoluteness.

In this field quite ordinary men, using what are in the last analysis only the tools which are generally available in our society, manage to unfold for themselves and all others who wish to learn, the rich story of one aspect of the physical world, and of man's experience. We learn to throw away those instruments of action and those modes of description which are not appropriate to the reality we are trying to discern, and in this most painful discipline, find ourselves modest before the world.

## Can This Discipline Be Applied to Other Fields?

The question which is so much in our mind is whether a comparable experience, a comparable discipline, a comparable community of interest, can in any way be available to mankind at large. I suppose that all the professional scientists together number some one one-hundredth of a per cent of the men of the world—even this will define rather generously what we mean by scientists. Scientists as professionals are, I suppose, rather sure to constitute a small part of our people.

Clearly, if we raise at all this question which I have raised, it must be in the hope that there are other areas of human experience that may be discovered or invented or cultivated, and to which the qualities which distinguish scientific life may be congenial and appropriate. It is natural that serious scientists, knowing of their own experience something of the quality of their profession, should just today be concerned about its possible extension. For it is a time when the destruction and the evil of the last quarter century make men everywhere eager to seek all that can contribute to their intellectual life, some of the order and freedom and purpose which we conceive the great days of the past to have had. Of all intellectual activity, science alone has flourished in the last centuries, science alone has turned out to have the kind of universality among men which the times require. I shall be disputed in this; but it is near to truth.

If one looks at past history, one may derive some encouragement for the hope that science, as one of the forms of reason, will nourish all of its forms. One may note how integral the love and cultivation of science was with the whole awakening of the human spirit which characterized the Renaissance. Or one may look at the late Seventeenth and Eighteenth Centuries in France and England, and see what pleasure and what stimulation the men of that time derived from the growth of physics, astronomy and mathematics.

What perhaps characterizes these periods of the past, which we must be careful not to make more heroic because of their remoteness, was that there were many men who were able to combine in their own lives the activities of a scientist with activities of art and learning and politics, and were able to carry over from the one into the others this combination of courage and modesty which is the lesson that science always tries to teach to anyone who practices it.

## Can the Spirit of Science Be Taught?

And here we come to a point we touched earlier. It is very different to hear the results of science, as they may be descriptively or even analytically taught in a class or in a book or in the popular talk of the time; it is very different to hear these and to participate even in a modest way in the actual attainment of new knowledge. For it is just characteristic of all work in scientific fields that there is no authority to whom to refer, no one to give canon, no one to blame if the picture does not make sense.

Clearly these circumstances pose a question of great difficulty in the field of education. For if there is any truth in the views that I have outlined, there is all the difference in the world between hearing about science or its results, and sharing in the experience of the scientist himself and of that of the scientific community. We all know that an awareness of this, and an awareness of the value of science as method, rather than science as doctrine, underlies the practices of teaching to scientist and layman alike. For surely the whole notion of incorporating a laboratory in a high school or college is a deference to the belief

*(Continued on Page 85)*

# SCIENTISTS AND SOCIAL RESPONSIBILITY

**P. W. Bridgman**

*Do scientists have a unique responsibility to society, and if so what is the character of this obligation? This is a practical question for those who are torn between a desire to devote themselves exclusively to science and an urge to promote the political and educational activity undertaken after the war. We present varying points of view on this problem, in the form of comments on a speech delivered by Dr. Bridgman before the A.A.A.S. in December, 1946. Dr. Oppenheimer's article on Page 64 bears in part upon the same subject. Dr. Bridgman is Hollis Professor of Mathematics and Natural Philosophy at Harvard, and received the Nobel Prize for Physics in 1946 for his work in the field of high pressures. His speech is reprinted from THE SCIENTIFIC MONTHLY for August 1947 by the kind permission of its editors.*

The general public is becoming increasingly conscious of the impact of science on the whole social structure, and the scientist has himself in the interval since Hiroshima displayed a noteworthy concern with the social effects of his discoveries. This has resulted in the formation of societies of scientists dedicated to controlling as far as possible some of the aspects of scientific discoveries. There is growing up among scientists a more or less articulate philosophy of what the relation should be between science and society as a whole. It seems to me that it is a matter of the greatest importance what this philosophy is, and that it may well be determinative of the future course of civilization.

There are, I think, unfortunate features in the present trend of this philosophy, and I should like to devote part of this discussion to them. This will involve giving a rather broad and liberal interpretation to our topic. I would in any event be constrained to place a liberal interpretation on it, because it is my feeling that the "scientific method," in the narrow sense in which scientific method is often understood, does not have a very immediate application to determining the ends for which scientific discoveries are used. I like to say that there is no scientific method as such, but rather only the free and utmost use of intelligence.

In certain fields of application, such as the so-called natural sciences, the free and utmost use of intelligence particularizes itself into what is popularly called the scientific method. From this point of view I should like to rephrase the topic for discussion to read "What is the most intelligent way of dealing with the uses of scientific discoveries?" A discussion from this broad point of view will necessarily involve aspects of social philosophy, and in particular the philosophy of the relation of science to society.

## The Meaning of Responsibility

The detailed discussion might well start with such questions as: How far is it desirable that scientific discoveries be controlled? or, What "ought" to be the attitude of the scientist toward his own discoveries?

No discussion along these lines will get very far before the word "responsibility" occurs. Let us examine the implications of this word. It is frequently stated that science is responsible for the uses made of scientific discoveries. This is obviously a highly abstract statement. The meaning must be that *scientists* are responsible for the uses made of scientific discoveries. But even this is so general as to have little meaning. Does it mean that scientists as a group are responsible? But what is responsibility that it can pertain to a group?

Here we begin to encounter shades of meaning and ambiguities in the word responsibility itself. A few people apparently use the word in a purely factual sense with no further connotations. From this point of view it can certainly be said that scientists are "responsible" for the uses made of scientific discoveries, for the simple reason that the discoveries cannot be used until after the discoveries are made, and the discoveries are undeniably made by scientists. Responsibility in this sense merely denotes a link in the causal chain. But I believe that this colorless and factual use of the word is comparatively rare. The more conventional usage implies a moral obligation and involves a moral condemnation if the obligation is not met.

To say that "scientists are responsible for the uses made of scientific discoveries" implies, according to what I believe is the usual usage, that each and every scientist has a moral obligation to see to it that the uses society makes of scientific discoveries are beneficent. This is getting pretty near home. It means that *I* have a moral obligation, and that if I do not meet the obligation I shall be deemed culpable by society and may justifiably be disciplined. The discipline that would be imposed is the natural and obvious one, namely, loss of scientific freedom. This is, I think, the temper of an important part of society today, and the attitude seems to be growing. Furthermore, it is an attitude in which a number of scientists, particularly those of the younger generation, are showing a tendency to concur. Any such concurrence arises, I believe, from a failure to realize the larger implications and involves an essentially short-range philosophy of the relation of the individual to society.

I think it is obvious that the thesis that the scientist is responsible for the uses made of his discoveries must involve the assumption that there is something special and exceptional in the situation. For certainly in more common situations individual responsibility is not considered to extend to all the consequences that may be initi-

ated by the act of the individual. The miner of iron ore is not expected to see to it that none of the scrap iron which may eventually result from his labors is sold to the Japanese to be used against his country. Such an extension of responsibility would be absurd because of the impracticality of it, and in particular would make impossible that specialization and division of labor that is one of the foundation stones of our modern industrial civilization.

## Ideal Society Allows Freedom to Specialize

Furthermore, it is obvious that if such detailed and individual responsibility were imposed a certain ideal of society implicit in the thinking of many of us would have to be abandoned. The society of this idealized vision is a society so constructed that every individual in it may be allowed to strive to choose for his life work what he can do best.

Unfortunately, society is still tragically far from this ideal for the average man, but our departure from the ideal arises, not from failure of good intentions, but from the practical difficulty that we have not yet found a mechanism that makes this possible. However, many individual scientists, so far as they have been allowed to follow the driving force of their inner scientific compulsion, have come pretty close to this ideal. From the point of view of society, the justification for the favored position of the scientist is that the scientist cannot make his contribution unless he is free, and that the value of his contribution is worth the price society pays for it. The demand that the individual scientist be responsible for the uses made by society of his discoveries would constitute a repudiation of this ideal. For if I personally had to see to it that only beneficent uses were made of my discoveries, I should have to spend my life oscillating between some kind of a forecasting bureau, to find what might be the uses made of my discoveries, and lobbying in Washington to procure the passage of special legislation to control the uses. In neither of these activities do I have any competence, so that my life would be embittered and my scientific productivity cease.

The thesis of the responsibility of the individual scientist therefore involves a repudiation of the general ideals of the specialization and division of labor, and the ideal of, as far as possible, each man to his best. This repudiation can be justified only by some special feature, and the only justification that I can see which is to be taken with any seriousness is the thesis that scientists are in some special way qualified to foresee the uses society will make of their discoveries, and to direct and control these uses. This thesis does indeed seem to be tacit in much of the popular discussion. The question now is whether this thesis is true, and, if so, whether it constitutes justification for the imposition of responsibility.

As a physicist with pride in my profession, I would naturally be loath to admit that a physicist could not do a better job than outsiders in controlling the uses made of discoveries in physics, but nevertheless I think an inspection of such activities of physicists as their attempts during the last year to get through Congress a bill establishing the National Science Foundation would show that the batting average of even the physicist would presumably be so low as to make it unprofitable for society to support him in the role of prophet and administrator. For of course society must recognize that if it imposes responsibility on a man it must be prepared to support him in the exercise of that responsibility.

## The Basis of Service and Recompense

Leaving further elaboration of this question to the tender mercies of others, I now address myself to the question of whether, even granted that scientists are specially qualified to foresee, direct, and control the uses made of their discoveries, society should therefore hold them responsible for the uses made of their discoveries. I think that the temper of the times is such that many people would answer this question with an unqualified yes. Such an answer implies a social philosophy that has been growing rapidly in this country, namely, that the community has a right to exact disproportionate service from special ability. It is epitomized in the Marxian epigram "From each according to his ability, to each according to his need."

Three stages of evolution can be recognized in the present philosophy of the relation of the individual to society. The first granted the right of the bright people to exploit the stupid ones; the second recognized the right of everyone to receive from society a reward proportional to his contribution to society; and the third and present stage recognizes the right of the stupid people to exploit the bright ones. It is perhaps obvious that my sympathies are with the second, or the median, of these three philosophies.

The third philosophy, insofar as it involves anything beyond the more or less disguised willingness of the majority to use naked force, is based on a metaphysical concept of society as some superthing, transcending the individuals who compose it. This, to my way of thinking, does not make sense. Society is composed of you and me; society does not have an individuality of its own, but is the aggregate of what concerns you and me. The function of society is expressible in terms of its relations to the individuals who compose it, and any justification for the acts made by its members is to be found only in the effects of these acts on the members of society as individuals.

It seems to me that the thesis of the right of society to exact disproportionate service from special ability can be analyzed very simply. If society exacts disproportionate service, this means that certain individuals in society, acting in their collective capacity, are willing to exact disproportionate service from other individuals. But I, as an individual, would certainly not presume to think of demanding that my neighbor give me special service merely because nature had endowed him to do the job better than I could do it myself.

The sort of thing I am unwilling to do in my individual capacity I am also unwilling to do in my capacity as a member of a group. Furthermore, it seems to me only decent and self-respecting for me to do my best to see to it that the group to which I belong does not act in a way in which I as an individual would not be willing to act. If every member of society applied to his social acts the same criteria of decency and self-respect that he applies to his individual acts, the problem of the exaction by society of disproportionate service from special ability would not arise.

The assumption of the right of society to impose a responsibility on the scientist which he does not desire obviously involves acceptance of the third philosophy, that is, the right of the stupid to exploit the bright. There are, I believe, specific objections to the application of this philosophy in the present situation, apart from the gen-

eral considerations just mentioned. It is not necessary. Society can deal with the issues raised by scientific discoveries by other methods than by forcing the scientist to do something uncongenial, something for which he is often not fitted. The course of action that can accomplish this seems to me the only self-respecting one.

## Control of the Scientist Is Not the Solution

The applications of scientific discoveries are very seldom made by the scientists themselves, but are usually made by the industrialists. It is the manufacture and sale of the invention that should be controlled rather than the act of inventing. This could surely be accomplished by specific action rather than by throwing out baby and bath together. One can think of revisions in the patent laws, for instance, that would be pertinent. Or society can control the situation by other means already in its possession. If it had not wanted to construct an atomic bomb, it need not have signed the check for the two billion dollars which alone made it possible. Without this essential contribution from society the atomic bomb would have remained an interesting blueprint in the laboratory.

Why is it that there is such popular clamor for dealing with this situation by the tremendously clumsy and backhanded method of imposing responsibility on the individual scientist, a method which involves the sacrifice of fundamental principles and the development of social mechanisms of more than doubtful practicality? I suspect the clamor arises from the unconscious operation of very human motives. The cry of responsibility is often no more than the cry of a lazy man to get someone else to do for him what he ought to do for himself.

There may perhaps be a small element of despair in the clamor. It is obvious that if society would only abolish war, 99 percent of the need for the control of scientific discoveries would vanish. Furthermore, it is obvious enough that the abolition of war is the business of everyone. The difficulties of doing this, however, appear to have become so enormous that the average man may well despair of being able to accomplish it himself. Into this situation comes the vision that if only some *deus ex machina* would stop scientific discoveries from being put to bad uses we could all be at peace in our minds. Whereupon the human race, with its capacity for wishful thinking and rationalization, needs only this hint to invent the legend of the responsibility of the scientists for the uses society makes of their discoveries. Let society deal with this situation by the means already in its hands, means by which it deals with similar situations. If it truly believes that the peculiar qualifications necessary to deal with the misuse of scientific discovery are to be found among the scientists, which I, for one, very much doubt, then let it create mechanisms and make opportunities by which those scientists who can do this sort of work well will be attracted to this field, rather than to insist on its right to the indiscriminate concern of all scientists with this problem. And let the scientists, for their part, take a long-range point of view and not accept the careless imposition of responsibility, an acceptance which to my mind smacks too much of appeasement and lack of self-respect.

## The Scientist Needs a Social Philosophy

I believe it to be of particular importance that the scientist have an articulate and adequate social philosophy, even more important than that the average man should have such a philosophy. For there are certain aspects of the relation between science and society that the scientist can appreciate better than anyone else, and if he does not insist on their significance no one else will, with the result that the relation of science to society will become warped, to the detriment of everyone.

The social philosophy which seems to be spontaneously growing up among some of our scientists is, I believe, a short-range and inadequate philosophy. It is well known that the scientists who have shown the most articulate concern with the social implications of the atomic bomb are young. The philosophy that is coming into being betrays this. It is a youthful philosophy, enthusiastic, idealistic, and colored by eagerness for self-sacrifice. It glories in accepting the responsibility of science to society and refuses to countenance any concern of the scientist with his own interests, even if it can be demonstrated that these interests are also the interests of everyone. Such a philosophy is unmindful of long-range considerations and blind to the existence of other scales of values than those of the philosophers themselves.

What are the characteristics of an adequate social philosophy? It means to me that first and foremost this should be a "maximum-minimum" philosophy. That is, society should be so constructed as to allow the maximum number of its members to lead a good life, while at the same time the minimum of dictation and interference should be imposed on any individual in determining what shall for him constitute a good life.

## The Ideal Society Is Broadly Tolerant

The most outstanding characteristic of such a society is its tolerance. What would be a good life for one man would not be a good life for another. It is, I think, with regard to this minimum requirement that actual societies are most likely to fail. No society dedicated to a special thesis satisfies this requirement. A totalitarian society, such as that of Russia, in which a man may anticipate happiness if he thinks as the majority, but in which he may expect to be liquidated if he opposes it, is obviously not such a society. Neither is the conventional Christian society, with its thesis that the good life is the one devoted to the service of a man's fellows, and with the correlative assumption of the right of the community to impose this ideal on the individual. Both these types of society are too narrow.

The broadly tolerant society, committed to no special thesis as to what constitutes the good life, is evidently a late product in the evolutionary chain. When the struggle for survival is too intense, tolerance may well be a luxury society cannot afford. But as the struggle for survival ceases to dominate the social pattern, an increasing amount of tolerance becomes practical, until in the end the attainment of the maximum of tolerance may well become the dominating ideal. This, it seems to me, is the sort of society we should strive for; it also seems to me that in this country today a high degree of realization of such a society is possible.

What is the relation of the scientist to such a society? It seems to me that he occupies a position of high strategic importance, a position impossible of attainment for the man who has not directly experienced the significant factors basic to this type of society. The conception of what constitutes the

good life does not present itself as a primitive datum in consciousness, but is a product of cultivation and education. Furthermore, various ideals of the good life are possible, competitive with one another and to a certain extent mutually exclusive. The ideals that come to prevail will to a large extent depend on the self-conscious activities of those most concerned. It may even be that the ideals will have to be fought for.

### The Scientist's Relation to Society

What constitutes the good life for the scientist does not at once appeal to the majority as constituting the good life. Nay, more than this, without education the majority cannot be trusted to see that it is to the advantage of the community as a whole that the scientist be allowed to lead his good life. With education, however, I believe that this can be accomplished, and that the scientist is strategically situated to impart this education. It is, of course, easy for anyone to see that the material benefits we now enjoy would not have been possible without scientific activity and to see that for this reason science should be supported. What I have in mind, however, is something less material. I think the scientist, in endeavoring to impart the vision of what this is, would do well not to take a too narrow view. The scientific life, which for him is a good life, is a special kind of a more general life which is also a good life, namely, the life of the intellect.

I think the scientist's most important educative task is to get the average man to feel that the life of the intellect not only is a good life for those who actively lead it, but that it is also good for society as a whole that the intellectual life should be made possible for those capable of it, and that it should be prized and rewarded by the entire community. It is perhaps a gamble that society as a whole can be made to feel this. But I believe it is a gamble to which the scientific man is committed. If the human race is such a sort of creature that it cannot be made to feel that intellectual activity and satisfaction of the craving for understanding are goods in themselves, then we might as well shut up shop here and now, and those of us who are made that way henceforth get the intellectual satisfactions necessary to us as best we can, surreptitiously and in spite of our fellows.

Example itself can be educative. Appreciation of the element of high adventure in achieving understanding of the ways of nature should not be difficult to impart. In other fields human beings do this. There must be widespread sympathy with, and understanding of the mountain climber who, when asked why he had to climb mountains, replied, "Because the mountain is there." I believe that most men similarly can be made to feel the challenge of an external world not understood and can be made to see that the scientist has to understand nature "because nature is there."

The challenge to the understanding of nature is a challenge to the utmost capacity in us. In accepting the challenge, man can dare to accept no handicaps. That is the reason that scientific freedom is essential and that artificial limitations of tools or subject matter are unthinkable. The average man, I believe, can be made to see that scientific freedom is merely freedom to be intelligent, and that the need for this freedom is born with us, and that we will practice it in the inmost recesses of our thoughts no matter what the external constraints. And I believe also that the average man can be made to see that the imposition of restraints on the freedom to be intelligent betrays fear of the unknown and of himself, and that he can be made to feel that this fear is an ignoble thing. My gamble is that the human race, once it has caught the vision, will not be willing to yield to fear of the consequences of its own intelligence.

It may appear that we have been straying rather far from our ostensible topic. I think, however, that from the broad point of view we have not. What we have been saying amounts to saying that the most intelligent way of dealing with the problems arising from scientific discoveries is to create an appropriate society. This society will be a society that recognizes that the only rational basis for its functions is to be sought in its relations to the individuals of which it is composed; a society in which the individual in his capacity as a member of society will have the integrity not to stoop to actions he would not permit himself as an individual; a society broadly tolerant and one which recognizes intellectual achievement as one of the chief glories of man; a society imaginative enough to see the high adventure in winning an understanding of the natural world about us, and a society which esteems the fear of its own intellect an ignoble thing. In a society so constituted I venture to think the problems created by scientific discoveries will pretty much solve themselves.

## COMMENTS ON DR. BRIDGMAN'S ARTICLE

### Scientists and Social Responsibility

*By Harold C. Urey*

Dr. Urey is Distinguished Service Professor of Chemistry at the University of Chicago, and vice-chairman of the Emergency Committee of Atomic Scientists.

I find it very difficult to disagree with anything that Professor Bridgman has said; his paper is a very scholarly presentation of the subject of the relative position of scientists as scientists, and society. In fact, it seems to me that the paper is so fundamentally correct that it might have been written almost any time. It might have been written by Plato, except of course that Plato would have used different terms, but his point of view might have been very much the same.

Professor Bridgman discusses the imposition of responsibility on the scientist by society. I do not quite see what leads him to the point of view that this has been contemplated in any serious way. In fact, does society impose a particular responsibility on any of its private citizens beyond the requirement that they shall obey the laws enacted by the proper, constituted authorities of that society? I believe that responsibility in our society is voluntarily accepted by people, and not imposed upon them, and hence that Professor Bridgman's whole argument in regard to the imposition of responsibility on the scientist by society is beside the point.

The real question in my mind is whether scientists should assume voluntary responsibility for attempting to see that the results of their scientific work are properly used. We do

not hold the miner responsible for the use of the iron which he mines from the earth, but it would be quite right and proper for him as a citizen to object to its being shipped to Japan as scrap iron to be used in a war against his country at some future date.

In spite of my agreement with Professor Bridgman's main thesis and many of its details, I am nevertheless annoyed by the paper as a whole. All of us, scientists included, have engaged directly or indirectly in two exceedingly destructive wars in this century, with every prospect, so far as I can see, of another one in the future. Perhaps nothing whatever could have been done or can be done to modify this course of events, though I think most of us act as though what we do may have some effect upon it. In view of the seriousness of this problem, I am annoyed when anyone of any particular profession presents a scholarly or unscholarly discussion of the subject which makes excuses for himself and his colleagues for not attempting to do anything about the serious situation in which we find ourselves in the twentieth century, to a very large degree because of the success of science and its technical applications. It seems to me that the whole question of society, responsibility, scientists, etc., belongs in the field of so-called academic discussion, at a time when much more immediate and practical problems need to be solved in order to avoid very dire consequences to us as individuals and to us as scientists.

## Publication Is the Chief Responsibility

### *By I. I. Rabi*

Dr. Rabi was Associate Director of the Radiation Laboratory and is Chairman of the Department of Physics at Columbia University.

There is one responsibility of the scientist, perhaps the only one on which general agreement will be found to exist, which Professor Bridgman neglected to mention. I am sure he will agree with the point of view. That responsibility is that of publication or communication of his results to the scientific world.

Long tradition has established this responsibility as an obligation on the scientist that partakes of something of the nature of common law. The cumulative nature of scientific knowledge puts the scientist in such great debt to the past and to his contemporary colleagues that his responsibility to present his results can hardly be honorably evaded.

This point of view is not inconsistent with the acceptance of employment by the scientist in an industrial or military laboratory where communication of results is, to say the least, not a primary objective. However, it must be emphasized that in working under such conditions, the scientist is in effect saying that a higher or more urgent responsibility interferes with or replaces his other and truly acknowledged responsibility for prompt and full communication.

If this thesis is accepted, the results which flow from the scientist's communications are entirely out of his hands. He may become an ardent advocate for a particular application of his scientific findings. His views, if well thought out, will obviously command a certain respect. On the other hand, if he exercises due scientific caution, he may not have any policy which he can with scientific honesty make public. One does not publish every scientific hunch or tentative idea. Self-discipline in scientific matters is one of the most important elements in the training of the scientist. One expects such discipline and restraint from scientists in matters outside his own field, otherwise he can have no special claim on public confidence.

The scientist can, of course, censor his own results. If he discovers something which can be turned to evil purposes, he can burn his notebooks, destroy his apparatus, and carry his secret to his grave. He is then accountable to no one. Nevertheless, very few would advocate such action. It smacks somehow of sabotage or arrogance. It implies a lack of faith in the human spirit. If the research is a joint effort and there is a difference of opinion among the investigators, the situation becomes melodramatic.

It is therefore clear that the scientist cannot take the responsibility for the manner in which society utilizes the knowledge he uncovers. Even a negative responsibility is difficult and unintelligible. A positive responsibility would consist in replacing the government of the United States by the National Academy of Sciences or the A.A.A.S. Much as most of us admire our scientific brethren, we would hardly care to go that far.

Our real social responsibility, and it is enough to load any man to his full capacity, is to do good, sound, honest science and to publish the results as clearly and objectively as we know how. Beyond that we enter the shadow land of dilletantism.

## A Question of Moral Responsibility

### *By Herbert Goldhamer*

Dr. Goldhamer is Associate Professor of Sociology at the University of Chicago.

Dr. Bridgman asks whether "each and every scientist has a moral obligation to see to it that the uses society makes of scientific discoveries are beneficent". This query would be moderately clear if we assume, as we probably may, that the question does not ask whether in fact every scientist does have (i.e. experiences) this as a moral obligation, but rather asks whether it is required (from given moral viewpoints) that scientists have such a moral obligation.

Dr. Bridgman, however, gives the question a decidedly different twist by indicating that the moral obligation of which he speaks is one that is (a) imposed (forced on, exacted from) the scientist by "society" and (b) breaches of which lead to judgments of culpability and disciplinary action (e.g. loss of scientific freedom). It is these two potential actions by society that primarily disturb Dr. Bridgman. Although this may be fairly clearly inferred from his discussion, the issue is nonetheless confused since the language of *moral* obligation that runs through the article now becomes inappropriate. If scientists perform a task simply as the result of external coercion and threat, it ceases to be a *moral*[1] obligation for them, as I at least understand the term.

I infer from the article (with a slight measure of uncertainty) that Dr. Bridgman personally feels no *moral* obligation in the matter and would not be disturbed by its absence in other scientists. It would be pointless here to "agree" or "disagree" with Dr. Bridgman. But one may be permitted at least to express regret that this is the case. Personally, I should wish that each scientist would assume the task involved as a matter of *self*-imposition and be deemed culpable *by himself* if he does not meet it. If a scientist does not *experience* this as a moral obligation, so much the worse (probably) for all of us.

On the other hand, I think with Dr. Bridgman that it is improper and un-

1. "Moral" is italicized when used in the sense of internally incorporated or self-imposed commands.

desirable that society, either in the form of a coercive public pressure or through its organs should *compel* scientists to assume the task of eliminating or minimizing harmful consequences of scientific advances and penalize them if they fail. Scientists are unwise if they cultivate, intentionally or unintentionally, in the public the misleading notion that they got us into this mess, and they are the ones who ought to be made to get us out of it.

I believe with Dr. Bridgman that the official organs of society should be encouraged to use the advice and services of scientists in this matter where their competencies (professional or non-professional) are relevant[2]. These are matters of social policy and I agree that coercive responsibility is bad social policy for the simple reason that the best efforts and advice of many scientists can be elicited more effectively without coercing them into the task or punishing them if they fail.

Dr. Bridgman apparently fears that restrictions on scientific freedom are apt to come after the imposition of responsibility as a penalty for failure. Such a situation would undoubtedly aggravate matters, but this preoccupation seems to obscure the much more immediate threat to scientific freedom. This derives from the growing awareness of the crucial significance of what the scientist does, with a consequent uneasiness about leaving him alone without any "supervision". This problem is already upon us.

There seem to be two ways (among others that are less palatable) of dealing with this. One is to convince both decision-makers and the public at large that "supervision" will not solve their problems or dissipate their worries. The other is to solve or alleviate the acuteness of the underlying problems, anxiety about which motivates the tendency toward "supervision". These tasks are, of course, not disjunctive. In the latter task it would seem that scientists motivated by a sense of *moral* obligation to their fellow men should be able to meet on common ground with those whose primary interest is in perpetuating the conditions of scientific freedom. The latter group will need to be convinced that this is a necessary task in the preservation of scientific freedom and that their help is needed even though they find the task, to use Dr. Bridgman's word, "uncongenial".

2. I am somewhat less skeptical than Dr. Bridgman of the frequency with which such competencies can be found in scientists.

## Assumption of Duties Is A Personal Matter

### *By Lee A. DuBridge*

**Dr. DuBridge, formerly of the Physics Department at the University of Rochester and Director of the Radiation Laboratory, is President of the California Institute of Technology.**

Though I personally have no quarrel with any of Dr. Bridgman's paper, I can see how there might be those who think of the term "responsibility" in slightly different terms. I agree with his argument that the only responsibility which society can impose upon a scientist by virtue of his being a scientist is that he be an honest and effective one. Other than this the only responsibility imposed upon him is that of being a "good citizen", a responsibility which, of course, is imposed on all citizens alike. Dr. Bridgman's argument that society can hardly impose additional special responsibilities on the scientist seems to me sound.

One might go a step further, however, and inquire whether scientists, individually or as a group, should volunteer to assume certain additional tasks as "responsibilities" because they believe that in performing such tasks they will be rendering a service either to science or to the community or both. On this point one will find, and should expect, a wide divergence of opinion among scientists themselves. This, indeed, must be the case, for a decision as to whether a scientist will volunteer his services for tasks outside of the laboratory must be an individual decision. Many will feel their best service to society is rendered by giving full attention to their scientific work; others will volunteer for additional tasks. No individual should try to impose his own decision on others.

What are the special areas in which scientists are especially equipped to render service to the community? Dr. Bridgman has mentioned one, namely, in representing to the community the value of science, and in general of the intellectual life. I believe there is an additional one, to provide the community with information on scientific and technical matters which affect the community welfare. Most scientists, each in his own way, are willing to render service in these fields. Those who choose to step beyond these matters into political affairs should recognize that they are stepping out of their role as scientists and into their role as citizens. They should not expect all of the scientists to follow them, or even to agree with them. They should not pretend they are speaking as scientists, or for all scientists. Most of all, Dr. Bridgman makes clear that in assuming such tasks the scientist should not pretend that he is performing a special social duty imposed upon him.

## A Social Scientist Comments

### *By William F. Ogburn*

**Dr. Ogburn is Distinguished Service Professor of Sociology at the University of Chicago.**

Professor Bridgman argues successfully that the scientist should not be held responsible for the uses to which his discoveries are put. To me this sound conclusion is rather simply reached. The scientist cannot be held responsible, because he does not know what the social effects will be. We do not hold a child responsible for his acts if he cannot see their consequences. How could Rutherford be held responsible for all the uses to which nitrogen will be put?

Even the scientists who made the atom bomb did not know but that the bomb would be used only as a threat to achieve a good end. But even if used to destroy cities, it still might be highly effective in helping to evolve more quickly a one-world in which war will be abolished for the long, long future ahead. The men who invented and developed the knife could not know all the uses to which it would be put.

Professor Bridgman argues less successfully about the solution of social problems caused by scientific discoveries. For instance, he states, "It is obvious that if society would only abolish war, 99 percent of the need for control of scientific discoveries would vanish." The solution of war, however, would not provide the solution of the problems caused, say, by the mechanical cotton picker, which it is said, creates unemployment in the millions, magnifies the difficulties of the Negroes, changes the agricultural system of the Southern States, brings a crisis in the political structure, and forces a considerable migration. The mechanization of cotton production is only one achievement of science. Every major scientific discovery probably creates a social problem. The author speaks rather emphatically on social questions for a physical scientist, who generally would not be expected to know any more about sociology than

Maynard Keynes would know about physics.

Professor Bridgman argues that social problems would solve themselves if the world would only adopt the scientists' way of life. He describes a society in which "the problems created by scientific discoveries will pretty much solve themselves." This society in which social problems solve themselves is one in which reason is applied to the relations of men, in which the members will have integrity, which is tolerant and appreciates intellectual achievement and the importance of understanding nature and which does not fear intellect.

These attributes of the good society recommended by scientist Bridgman are much the same as the traditional credo of science: suspended judgment, the life of reason, tolerance, high valuation of the intellect, brotherhood based upon the pursuit of truth which extends the frontiers of knowledge. But most professions and occupations have credos; the clergy, the military, the farmers, the city proletariat. Each is different, yet with one common characteristic, the belief that the ills of the world would be cured if it would only adopt "our" credo.

Social problems need a social science, not a faith, for their solution, just as diseases need a science for their cure, not a religion. Scientists are so much concerned with the beneficence of their discoveries and what they are doing that they are only dimly aware that social problems are created. The discoveries of medical science are viewed as wholly good, without any idea that they disturb the balance of births and deaths, lead to population pressure, which is not unrelated to war, and to the low standard of living caused by overpopulation.

## Everyone Shares The Responsibility

### *By Eugene Rabinowitch*

**Dr. Rabinowitch is Research Professor of Botany in the Graduate School of the University of Illinois, and an editor of the BULLETIN.**

Two kinds of scientists will support Dr. Bridgman: those who agree with his premises; and those who do not care for the premises but like the conclusions because they sanction their natural disinclination to be diverted from research or teaching.

What are these premises? They include, in the first place, an ideal of society very similar to Plato's: a state whose affairs are managed by individuals dedicated to this pursuit and in which scientists (there is no reason why the same doctrine should not also apply to merchants, artists, and bricklayers) are not called upon to perform any uncongenial tasks of statesmanship.

Dr. Bridgman sees society not as a living organism, but as a mechanical sum of individuals Such a society has little place for collectives, classes, professions, religious or ideological groups—which at present stand behind the nation and the individual. Thus Dr. Bridgman sees only the attempt to saddle individual scientists with responsibility for the practical use of new discoveries, not the responsibility of scientists as a group for the misuse which humanity may make of the results of their efforts.

Dr. Bridgman implies that the best way to bring about the society he considers ideal is to act as if it already existed. He implicitly advises scientists to devote themselves to research, fighting only for the right to do this research independently and to publish the findings freely. Presumably, other citizens should strive similarly to engage in tilling their chosen fields without interference, and to fight only for the freedom to sell their produce.

Many will dispute the factual correctness of Dr. Bridgman's concept of nation and mankind as a mere sum of individuals. Others will disagree with the desirability of such a society as an ideal, even if it were feasible. Still others, who share Dr. Bridgman's preferences, will admit, albeit reluctantly, that the way to make its achievement possible does not lie in following his advice and retiring from the political field.

The type of society preferred by Dr. Bridgman is different from the political democracy America has been striving to achieve. The latter is based on the belief that affairs of state must be the concern of all citizens. Casting a vote in elections does not mean that an individual has done his full share in the conduct of public affairs. His special knowledge, the attitudes he has acquired in the pursuit of a trade or profession, or in association with a congenial group, should permit and obligate him to make a more specific contribution. With rare exceptions, his additional contributions are possible only through participation, in the affairs of state, of collectives, sharing special experience and attitudes; scientists are one of these collectives.

Not that scientists should be assigned the special responsibility for determining the application of technology to human affairs; but in a civilization in which technology plays a crucial part, the factual knowledge, the insight into future possibilities and the general objectivity and universality of science should not be absent from political councils.

One aspect of human affairs which is of greatest importance for the future is at present most clearly seen by scientists: the discrepancy between the advanced mastery of mankind over nature, and the obsolete political organization of the world. Even if Dr. Bridgman is right, and the ultimate ideal of society is one in which the intelligence of the bright is not exploited for the benefit of the stupid, does he believe that if the intelligent refuse to be so exploited and the stupid are left to shift for themselves, society will start moving towards this ideal? Does Dr. Bridgman believe that this country possesses in its politicians a class of Plato's "guardians," in whose hands the affairs of state can be left, not only without danger that the existing stock of tolerance within and good will without the nation will be squandered, but with good chance that it will be steadily increased? Perhaps; but he is unlikely to deny that tyranny and intolerance reign over a large part of the globe and that in the hands of many of the present rulers, the technological facilities created by modern science are likely to be used to destroy the very kind of society he is hoping to see established.

Is Dr. Bridgman not afraid that unless the individual and collective wisdom of all men of good will—including the scientists, individually and collectively—is brought to bear on the task of converting the present unsteady structure of human society into an edifice solid enough to house modern machinery, atomic bombs and biological pests will destroy, in the not too distant future, the stupid and the bright? Or does he expect that he will find satisfaction, as he contemplates the radioactive ruins of Harvard yard, in the thought that he, at least, had resisted all attempts to saddle him with responsibility that was not his?

# ATOMIC ENERGY IN THE NEWS

## NEW COMMITTEE ON ISOTOPE DISTRIBUTION

Appointment of a new Advisory Committee on Isotope Distribution was announced on January 13 by the AEC. This group will recommend to the Commission new policies governing isotope distribution and act as adviser to the Isotopes Division of the AEC on allocation of isotope materials.

The committee consists of Dr. G. Failla, of the Columbia University Medical School, Chairman; Dr. Hymer L. Friedell, Dr. A. H. Holland, Jr., Dr. J. G. Hamilton, Dr. Joseph W. Kennedy, Dr. Robley D. Evans, Dr. Robert F. Mehl, Dr. Austin M. Brues, Dr. L. N. Nims, Dr. H. A. Barker, Dr. Henry Borsook, and Dr. Paul C. Aebersold, Chief, Isotopes Division, AEC, Oak Ridge.

## AEC CONSOLIDATES REACTOR RESEARCH

The AEC announced on January 1 several changes in the location of projects and in contractors for operation of the projects.

1. Reactor development previously planned for the Clinton National Laboratory at Oak Ridge, and for the Argonne National Laboratory will be consolidated at the Argonne National Laboratory under the direction of Dr. Walter H. Zinn.

2. The Clinton National Laboratory will develop research in chemical and chemical engineering problems in the field of nuclear energy, with emphasis on industrial applications.

3. The University of Chicago has withdrawn from the contract for operation of Clinton National Laboratory which it was to have assumed January 1. The new contractor, under agreement now being negotiated, is the Carbide and Carbon Chemicals Corporation, already the contract operator of the production facilities for U-235 at Oak Ridge.

Consolidation of the reactor research and development work in Chicago had been recommended by the General Advisory Committee in order to secure the maximum results from the work of the limited number of scientists and technicians qualified in this field.

The Clinton National Laboratory will continue to operate as a research tool the graphite reactor now there. It will continue also as the center for development in isotopes work and distribution and a focus for research in radio biology and health physics.

The Oak Ridge Institute of Nuclear Studies, organized by 14 southern and southwestern universities, will continue unchanged its program of study and training.

## GENERAL GROVES RETIRES

Lieut. Gen. Leslie R. Groves announced on February 2 that he had requested retirement from the army. Since giving up his command of the Manhattan Project, General Groves has been chief of the armed forces Special Weapon Project and a member of the Military Liaison Committee of the AEC.

## URANIUM ORE FROM THE BELGIAN CONGO

A newspaper report from Brussels on January 3 announced that the U.S. had purchased 3,650 tons of uranium ore from the Belgian Congo in 1946 at a cost of $5,332,000. Britain purchased 2,600 tons for the equivalent of $4,250,000.

## PERSONNEL SECURITY BOARD ANNOUNCED

On January 20 the AEC announced creation of a Personnel Security Review Board headed by Owen J. Roberts, former associate Justice of the U.S. Supreme Court.

Other members of the Board are Dr. Karl T. Compton, President, Massachusetts Institute of Technology; Hon. Joseph C. Grew, diplomat and former Undersecretary of State; George M. Humphrey, President, M. A. Hanna Co., Cleveland, Ohio; and H. W. Prentis, Jr., President, Armstrong Cork Co., Lancaster, Pa.

The function of the Board is to resolve questions referred to it by the Commission regarding personnel security clearance, and to develop policies, procedures and standards for resolving such questions. (The lines that such a policy might follow are described in an article by Harrison Brown and Byron Miller in the February issue of the BULLETIN.)

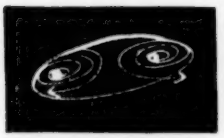
The Board will attempt to reconcile the maximum demands of national security with the adequate protection of AEC employees against unfounded accusations.

The Board may conduct hearings and initiate inquiries, including testimony or other evidence offered by an applicant or employee; call upon the Commission to furnish pertinent records, material or testimony; and make recommendations to the Commission for action to be taken regarding the granting or denial of security clearance.

## REPORTS TO CONGRESS

Two important reports have recently been submitted to Congress: The Joint Congressional Committee on Atomic Energy made its first report on January 30; the Atomic Energy Commission's third semi-annual report was presented on February 2. Condensed versions of these reports appear elsewhere in this issue.

# THE FIRST OFFICIAL REPORT ON AEC PATENT PROBLEMS



**Byron S. Miller**

*An Advisory Panel, appointed to consider policy, procedures, and staff organization for the implementation of the patent provisions of The Atomic Energy Act, made its first report to the AEC in September, 1947. The panel consisted of Casper W. Ooms, formerly U. S. Commissioner of Patents; William H. Davis, chairman of the Department of Commerce Patent Survey Committee; John A. Rienner, former president of the American Patent Law Association, and Hector W. Holmes, Boston patent lawyer. A critical summary of the conclusions of this report has been prepared for The BULLETIN by Mr. Miller, formerly Associate General Counsel of the Office of War Mobilization and Reconstruction, which acted for the administration in securing domestic atomic enery legislation. Mr. Miller is now mid-west director of the Commission on Law and Social Action of the American Jewish Congress.*

The first report of the AEC's Advisory Panel on patents is a welcome rejoinder to much of the diatribe that has characterized the patent bar's response to the patent provisions of the Atomic Energy Act of 1946. In a lengthy dispassionate report, the Panel upholds the Act's modification of the patent system in its relation to atomic energy as both necessary and wise, reviews the work of successor government agencies dealing with patent problems in this field, and makes initial recommendations on patent policy and administration to the Commission.

Because the subject is usually buried in technical verbiage, the patent provisions of the Act are probably less familiar to many than the research, control, and secrecy provisions of the Act.[1] This discussion of the report may be more intelligible if the Act's provisions and policy decisions are summarized at the outset.

## Background of the Report

Development of a patent policy for inventions in the atomic energy field required assurance of two basic objectives:

(1) the maintenance of secrecy, a goal fundamentally inconsistent with the purpose of the patent system, which is to encourage disclosure that others may improve on earlier inventions;

(2) the availability of discoveries for widespread public benefit. This new field, founded on a public investment of several billion dollars, portends enormous changes which should not be permitted to be withheld or delayed through patent monopolies.

It was desirable to attain these objectives in a manner yielding minimum interference with the incentives of the patent system. The Act determined these policy questions in Section II as follows:

Section 11 (a) (1) (2)—Inventions useful in atomic energy production or military weapons are patentable to this extent.

Section 11 (d)—AEC may take by condemnation any inventions useful in atomic energy production or military uses, or utilizing or essential to other uses of atomic energy.

Section 11 (b)—Atomic energy research exempted from all patents.

Section 11 (c)—Non-military utilization patents may be declared "affected with the public interest," thereby becoming available to all AEC licenses at reasonable royalties.

Section 11 (a) (3)—All new production and military inventions must be reported to AEC.

Section 11 (e)—Awards and compensation to be made by Patent Compensation Board for new inventions, patent rights revoked, patents condemned, etc.

The Advisory Panel consisted of Casper W. Ooms, then U.S. Commissioner of Patents, William H. Davis, Chairman of the Commerce Department Patent Survey, John A. Dienner, former president of the American Patent Law Association, and Hector M. Holmes, active Boston patent lawyer. Their Report was prepared after extensive consultation with the AEC and its staff.

## The Panel Reviews Provisions of Act

The Panel evaluated the patent provisions against the background of the Act's direct controls over production and utilization of atomic energy. It concluded that "the necessities of the situation compelled the kind of patent provisions which Congress embodied in the Act." With regard to secrecy, the Report commented:
. . . "nor would it be possible to control information if the normal processes of patent laws were allowed to operate in this field." (It might be added that the Panel seems to have succumbed to the semantic seduction of using the word "security" where "secrecy" was meant.)

Section 11 (a) (1) and (2) making some inventions non-patentable were specifically approved, the Report noting that such patents "would not only be superfluous, but the publication of the patents might destroy the secrecy that is frequently essential to the effectiveness of military weapons."

Other aspects of the patent section were endorsed as effective means of avoiding foreign control through patent holdings of inventions impor-

1. Some exceptions are Ooms' "Atomic Energy and U.S. Patent Policy," BULLETIN, Vol. 2, Nos. 9 and 10, and an article by James R. Newman and the author, entitled "Patents and Atomic Energy," *Law and Contemporary Problems*, XII, 746, (1947)

tant to national defense, such as were found to be in force at the outbreak of the recent war. The Report also remarked: "The Act makes scrupulous provisions for patents or patent rights cancelled by the Act or taken by the Commission under the Act."

The favorable tone of these general evaluations is somewhat marred by the Panel's effort, later in the Report, to equate the narrow patent clause of the Constitution with the broad policy declarations of the Act. Perhaps it devolves only upon patent law practitioners to say that "promoting the progress of science and useful arts" is the same as "improving the public welfare and increasing the standard of living." Certainly many "outsiders" would argue that there is some gap between the development of new inventions and widespread public availability of and benefit from these inventions.

Whether or not one accepts this effort to compress broad social standards into patent traditions, one must concur in the Panel's conclusion that even the hoary patent clause of the Constitution is by Act subordinated to the objective of "assuring the common defense and security."

## Relationship of AEC To Its Contractors

Even as a matter of law inventions are made only by natural persons. Hence, allocation must be made of patent rights in inventions made in the course of employment by the AEC or its contractors: the problem of "patent clauses." The Act contains no express provision on the subject (except to weigh the circumstances under which the invention was made in determining awards or compensation for patent rights taken away). The thorny nature of this problem is evidenced by the stormy history of the National Science Foundation legislation in the 79th Congress where even a compromise provision barely squeaked through the Senate only to die in the House, by complete omission of the problem from the Science Foundation bill passed by the 80th Congress (and vetoed), and by the lengthy report and recommendations for a government policy in this field made by the Attorney-General in mid-1947 but apparently marked for oblivion both by Congress and the Administration.

The Report reviews the practices of OSRD, the Manhattan District and the AEC. Since the personnel has been practically the same, the present operation is largely a minor refinement of original practices.

Substantially different policies apply to the rights given contractors over rights given to inventors. When the inventor is employed by the AEC, he can obtain no patent rights; when employed by a contractor, he may receive only what the contractor may give him out of its share, frequently nothing. Contractors, however, may and often have obtained substantial patent rights in inventions growing out of contract work financed by the government. The rationale for this policy is that the contractor's own development work in such cases has probably contributed more to the particular invention than the immediate contract under which the invention was made.

## Three Types of Patent Clauses Employed

The AEC, therefore, now employs three types of patent clauses:

*Type A*, under which the AEC decides what allocation should be made, usually keeping all rights. This clause is used in basic research contracts.

Under *Type B*, AEC also makes the allocation but the contractor always gets at least a license to use the invention in non-atomic energy (so-called "outfield") uses. This clause is used where the contractor has an established position in the field but is called upon to make an important development. Occasionally, the contractor has also been allocated the right to sublicense outfield uses.

In *Type C* clauses the contractor gets an almost separate patent in outfield uses. The AEC keeps all atomic energy use rights but the contractor gets a sole license for outfield uses with power to sublicense at will. This clause is used for installation of more or less standard equipment and for plant construction and operation by established companies.

The AEC has added a clause by which contractors waive all claims to pecuniary compensation on account of patent rights.

Though it is stated that Type A clauses have been used in 60% of all contracts; Type B in 25%; and Type C in 15%, no indication is given of the relative importance of the contracts so counted. Far more significant, the Panel reports: "No critical evaluation can be made in this report of specific inventions and the appraisal of the respective contributions of government and contractors which led to the apportionment of their respective patent rights." The Panel concludes that the allocation of patent rights must have been fair because the clauses have been accepted by the contractors without serious objection. No reference is made to the recommendation of the Attorney-General that all rights to inventions made under Government contract should be assigned to the Government except in emergency situations.

## Relationship of AEC and Patent Office

The report deals at some length with the twin questions of how the Patent office should handle patent applications affecting atomic energy and when the AEC should file applications to protect patent rights it has acquired.

The Panel agrees at the outset that filing with the Patent office is not necessary to *control* atomic energy inventions. They urge, however, that filing will often be desirable for "defensive" reasons, primarily to eliminate unnecessary claims for awards. Their recommendations may be summarized as follows:

A. *Production and military inventions (section 11 (a)(1) ).* No filing should be made. At present the Patent Office summarily rejects all applications in this field. This recommendation conflicts with the action of the Manhattan District in filing applications covering the bomb itself.

B. *Other non-secret inventions under Type A and Type B contracts.* Filing freely is recommended for several reasons: to supply ready proof of "reductions to practice" to overcome competing applications, to have other applications denied on lack of priority grounds thereby precluding claims based on the theory that denial was founded on the Act, to litigate competing claims by interference within the Patent Office rather than after a separate patent has been issued, narrow the scope given to related patents, to make formal declassification easier and more effective, and to make sure that such patents are freely available as publicly owned.

C. *Non-secret inventions under Type C contracts.* AEC should file sparingly, purportedly because it is protected by contract. But there may be cases where other inventors will file for atomic energy uses and not be blocked by the contractor's patent in outfield uses.

D. *Inventions warranting secrecy.* Under a law shortly to expire but likely to become permanent, the Government may direct the Patent Office to hold the application under secrecy order and not process it. Even apart from this act, it is often possible for the Government to achieve the same result by delaying certain procedural steps. Either tactic assures secrecy only before a patent is issued, both in effect preventing issuance and therefore *pro tanto* eliminating the patent system. In recommending a study of this problem with a view to legislation, the Panel makes no mention of the possible applicability of the secrecy provisions of the Atomic Energy Act to the workings of the Patent Office.

E. *Issuance of patents to AEC.* While the filing of applications is recommended, the Panel disclaims any opnion on whether patents should be issued to and owned by the Government, relegating such questions to "solution on a Government-wide basis."

## Operations Within the AEC

A. *The Patent Compensation Board.* As of the date of the Report, the Patent Compensation Board provided in the Act had not yet been selected, although the staff was reported to be developing regulations and procedures for its operations. Only one claim had been filed, six more appeared in the offing, and in perhaps twenty other instances a partial claim was anticipated. Several recommendations are made: (1) that a limit of time be established for filing claims. The Act is silent and although regulatory action is suggested, its validity seems at least doubtful; (2) when interference proceedings in the Patent Office are stalled by secrecy order, claims on account of such rights should be accepted; and (3) whenever possible, negotiated settlements are urged.

The Panel stated but refrained from making any recommendation on the maintenance of secrecy in compensation proceedings. By indirection it suggested a rule that proceedings be private and papers be impounded, but the validity of this procedure was not discussed. On the further questions of court review of the proceedings and how to avoid disclosure to claimant, his counsel and witnesses, the Panel was content merely to acknowledge their existence.

B. *Taking Private Patent Rights.* Section 11 (d) of the Act is the first legislation grant of power to a government agency to take private patent rights by exercise of the right of eminent domain. The Panel aptly points out that this power may be used to condemn less than the total patent right, a license for example. Thus, this power overlaps the AEC's power to declare certain patents "affected with the public interest" under Section 11 (c) in order to permit their use by AEC licenses.

The Report recommends either waiting for a claim of infringement to be made or exercising the condemnation power, rather than declaring any patents affected with the public interest, in order to create "less disturbance . . . in industry and in the patent system." It is stated that the AEC agrees with this recommendation. Perhaps the Panel's timidity about having the Commission find patents to be affected with the public interest is not unconnected with its narrow interpretation of the Act's broad social objectives, commented upon earlier.

## Conclusions of the Report

As the foregoing review indicates, a number of unsettled problems remain. These may be listed:

1. *Facts on the allocation of patent rights under existing contracts.* So long as the AEC departs from the Attorney-General's recommendation that all patent rights arising under Government contract be retained by the Government, there should be some demonstration that the AEC's present policy is in fact reasonably strict in retaining patent rights for the Government.

2. *Patent Office procedures.* Legislation is apparently necessary to permit applications in secrecy areas to be withheld indefinitely without disclosure of restricted information to competing applicants. Since the problem is not unique to atomic energy, such legislation might give government agencies powers to excise the patent system in wide fields related to the national defense.

3. *Secrecy in patent compensation proceedings.* The conflict between the implacable demands of secrecy and fundamental notions of due process bobs up here too. Considerable publicity has been given to the problems of protecting classified information in prosecutions for secrecy violations under the Atomic Energy Act and to protection of confidential sources in disloyalty procedures for Federal employees. It is possible, however, that non-disclosure of classified information in patent compensation proceedings may be more justifiable on the theory that the property right in compensation for cancelled patent rights is of a lesser dignity than the personal right of a defendant in a criminal case or of a government servant in his professional reputation.

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ERRATUM—The author of the unsigned review of Eric Ashby's *Scientist in Russia* in the February BULLETIN was Eugene Rabinowitch.

## A LETTER TO THE EDITORS

### How to Implement Dr. Szilard's Proposal to Mr. Stalin

December 27, 1947

Dear Sirs:

The Atomic Scientists, in their early history, won two most impressive victories. Soon after V-J day, the May-Johnson Bill for the control of atomic energy, drafted by the military, seemed almost certain of passage without public debate. The scientists, by vigorous, *united,* and *almost unanimous* opposition, helped to defeat that bill and finally to bring about the passage of the highly enlightened McMahon Bill.

In the fall of 1945, President Truman, in a statement to the press at Reelfoot Lake, Tennessee, and later in his Navy Day speech, gave every indication that he considered atomic energy as a sacred trust given to the American people, and certainly not to be shared with the rest of the world before some far-distant day when peace and good-will would be securely established. The Atomic Scientists rose up against this attitude *almost in unison,* and their protests were largely responsible for the subsequent adoption of the Acheson-Lilienthal report as the basis of an enlightened foreign policy.

The lesson is clear. When the scientists are able to place their *vigorous and united* support behind an important and intelligent proposal for national policy, their chances of success are extremely good even when they have to cope with the formidable obstacle of contrary opinions already formed. They have never won any comparable victories when they lacked such unanimity.

Today the scientists find it impossible to agree on any long-term foreign policy for the United States for the same reason that the public is confused and divided and uncertain: We are in disagreement as to the answers to the fundamental questions, "Would the rulers of Russia be willing to reach a general world settlement today if they could be convinced of the sincerity and goodwill of the United States; or are they unalterably intent on fomenting chaos for their political advantage?"

Any foreign policy of the United States which today is to gain the united support either of the scientists or of the public must leave in abeyance the answers to these questions. If it is to satisfy the needs of the nation, it must be a policy which will leave open the door to peace with Russia in case the Russian rulers wish to enter that door; it must be a policy which will force the Russian rulers to give an early indication of whether or not they do want peace, and, if they do, what general kind of settlement they would consider acceptable; and it must protect our military security to the highest degree possible until the American people become convinced that the threat of war has receded.

The purpose of this letter is to urge the scientists that, if they are again to offer effective leadership to a nation which desperately needs guidance, they must agree on a limited program of the nature described above. One measure in such a program is suggested in the "Letter to Stalin" by Dr. Leo Szilard which appeared in the December issue of this BULLETIN. Dr. Szilard proposes that Stalin make a series of speeches to the American people in which he would present "a clear picture of a general settlement within the framework of a post-war reconstruction of the world, a settlement that would enable Russia and the United States to live in peace with each other."

He also suggests to Stalin that "you would go a long way towards convincing the American people that they may expect fair play from you if you invited the President of the United States to address the Russian people just as often as you speak to the American public and accorded just as much publicity to his speeches in Russia as is given to yours in America."

#### Speeches Should Be Arranged Through UN

Dr. Szilard explained that he considered it inadvisable for him to make his proposal to President Truman rather than to Stalin. However, I believe it would be highly appropriate for *the American people* to demand that our government undertake to arrange such an exchange of speeches.

Our government could take the proposal to the General Assembly of the United Nations, and request that body to put what pressure it could on the Russian government to accept the proposal—and perhaps to establish a general policy that whenever one nation fears that war with a second nation may be approaching, it may request the General Assembly to use its influence for the arrangement of such a series of addresses by the chief executive of each nation to the people of the other. If Stalin should refuse such a request by the General Assembly, that would go a long way toward answering the same question in the minds of the representatives of most of the nations of the world, "What are the aims of the men in the Kremlin?"

Time is becoming so short that each writer who has a definite idea as to what could be done to break the present impasse should state that idea in a form which indicates as clearly as possible, to each reader, the action he thinks that reader can take to implement his proposal. In accordance with this, I suggest that the various organizations of the Atomic Scientists, and all readers of this article who agree with the views expressed herein, adopt as their immediate program the seeking of public support for the following petition:

Whereas, relations between the United States and Russia are becoming worse from month to month, and

Whereas, we the undersigned people of the United States do hope with all our hearts that war between the two countries can and will be avoided,

Therefore, we do hereby petition the President and the Congress of the United States to seek to arrange with the Russian government for a series of addresses to the American people by Prime Minister Stalin and a series of addresses to the Russian people by President Truman, and for such addresses to be given wide publicity in both countries, in the hope that this may lead to a better understanding by each country of the objectives of the other.

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# WHAT SHOULD THE ATOMIC SCIENTISTS DO NOW?

*Richard L. Meier*

*Previous articles in the BULLETIN by John A. Simpson and W. A. Higinbotham have described the history and activities of the Federation of American Scientists. Mr. Meier, who last fall succeeded Mr. Higinbotham as executive secretary of the FAS, considers the lines of action that should be followed in the future.*

The scientists, in their battles for atomic energy control, are no longer headline material. Their glamor and novelty have faded. Has their string run out after only thirty months of activity? What is left that scientists can do?

During a recent 8,000 mile tour covering all the centers of activity, I found scientists in various stages of frustration. There was no confidence in any specific plan of action. Still these people were not entirely pessimistic. There is, in American tradition, a certain confidence that no critical problem is insoluble. Many were willing to admit their ineffectiveness, many had become immersed in personal problems, but none recommended the cessation of effort.

Success in the passage of the McMahon bill and the appointment of an enlightened civilian commission mislead many of us into thinking that the international situation would be just as tractable. We succeeded—to a point—in making our ideas on international control accepted in Washington, but the divergent ideas of American post-war foreign policy, and the lack of response to the American control plan in the Soviet Union lead to a stalemate. The disappointment has been severe, and the question has been raised whether continued organized effort by the scientists may not do more harm than good.

Actually, the campaign for international control of atomic energy and eventual elimination of war has only begun. Some say that this is a problem for political scientists and statesmen, and that natural scientists are venturing beyond the field of their competence when they deal with social problems and international affairs. Yet the problems of peace are complicated at every turn by the implications of science and technology. Scientists have a language and a set of symbols which fit our needs for precise communication in this field very well, but the language *and the meaning* are unintelligible to the non-scientists who must make decisions. It is the urgent duty of citizen-scientists to make sure that translations are available wherever scientific or technical facts affect public safety.

For a while many thinking people hoped and felt that perhaps the scientists could lead the way to peace. All other prophets had feet of clay, but the statements of scientists were founded on fact and verifiable experience.

## Avenues of Intelligent Cooperation

However, it is slowly being realized that scientists cannot come up with answers where no answers as yet exist. A large share of these answers are quite outside the special experience of the scientists. Their role is not that of a unique leadership, but of intelligent cooperation.

*We must keep ourselves informed.* The self-evidence of this statement makes it seem trite, but it needs continuous emphasis. Before any constructive contributions to the solution of political problems can be provided, our level of information on these problems must be high, a condition which is seldom fulfilled. Much of the material pertinent to the thinking of scientists is available for the asking, mainly in Washington and New York. Therefore, it has been a function of the Federation of American Scientists to ferret out this information and relay it to the Associations, who in turn are supposed to transmit it to members. So far, our organizations have done only moderately well in this respect. Perhaps new instruments of communication should be explored.

*We should promote public education.* It is not easy for scientists to realize that the mere purveying of information, logically derived from factual data with the help of reasonable assumptions, does not make much of an impression upon the public at large. I have met many chemists and physicists, and others, who have just come to realize that people act upon attitudes which are seldom logically derived. A much smaller number realize that they themselves base most of their own social decisions upon similar irrational preconceptions. The scientist-educator *must* understand the vagaries of public opinion on atomic control and related issues, and thus be able to distinguish what is practical and acceptable from what may be abstractly right but is practically infeasible.

The natural impulse of atomic scientists to broadcast facts turned out to be rather good judgment; but to finish the job of preparing the American public to undertake major changes of policy needed for the control of weapons of mass warfare, we cannot risk that our message will misfire. Experts in public education and social psychology say that to be realistic we must think in terms of reinforcing desirable attitudes and discrediting those that are pernicious.

*We should get at the crux of international misunderstanding.* We have never undertaken a thorough unprejudiced study of international relations. Has sufficient information been delivered to the right place in the chain-of-command here or abroad? Has the U.S. used the right techniques and the correct sequence of actions to assure others of the sincerity of our control plans? Why should Russian scientists associate "world government" with "monopolism"? It is high time we started

to consider which actions of the U.S. or its scientists will induce action of a predictable nature on the part of other nations, and plan our actions accordingly.

*We should urge our government to undertake specific measures of good will.* No words will convince suspicious people that the United States does not desire to dictate to the world politically, economically, and culturally. But deeds speak very forcefully. The Federation of American Scientists had worked for a long time for the international distribution of radioactive isotopes. The announcement was hailed by countries throughout the world as a most constructive act. There are many such measures which lie either wholly or partially in the realm of science, that could be proposed.

Wherever possible, the instruments of international institutions, such as the United Nations, should be employed. An action taken in that manner cannot easily be construed as bargaining for political support. We hope that measures of good will on our part may be matched, perhaps after an interval of time, by similar measures on the part of other nations. If this occurs, the international tensions leading toward war will naturally decrease, and the atmosphere of the peacemaking process may be improved.

## Should Apply Principle of Chain Reaction

There are not many scientists in the United States, and only few of them have the proper background and ability to accomplish much outside their traditional field. How can a movement of such a minor proportion affect national or international affairs?

It is sufficient to say that it has. Scientists have long known about "chain reactions", situations where an effective blow is delivered by the application of a small amount of energy through the release of a "trigger." The scientist must choose those points where concentrated effort can contribute most to the creation of the world community: Making speeches before important audiences, helping to produce documentary films, preparing materials for secondary school teaching, organizing county or statewide programs of public education, proposing ideas suitable for government action in domestic or foreign field, publishing competent journals, supplying background material for press, radio, and magazines. All such activities are chain-reacting.

There are perhaps a thousand scientists in the United States who have actively participated during the last two and one-half years in what has been called "atomic education". Where it is geographically possible, these men and women are members of local associations, and the aggregate of associations, plus a few hundred members-at-large constitute the Federation of American Scientists. Two thousand more have become members, but for any of a multitude of reasons have been unable to contribute anything more than moral support.

A large proportion of the thousand active members might be available as much as 5 or 10 hours a week for coordinated effort; a few hundred are earnest crusaders who can be counted on to put in several times that effort for weeks for months at a time. Perhaps as many as half a dozen could be induced to abandon scientific work for a year or two and devote full time to such efforts; this pool could be continuously replenished by those on sabbatical leaves or informal turns of duty.

Three non-affiliated groups are doing a very respectable job, and given a little stimulation, many more may arise. The Rocky Mountain Committee on Nuclear Energy centers around Denver and Colorado Springs, with 20 to 30 people actively carrying on an enterprising program. In Los Angeles there is a Council on Atomic Implications composed mainly of veterans of the University of Southern California. They have carried on many original and relatively large scale activities. The veterans are less inhibited than scientists, and this has permitted them to develop some very effective educational techniques, while at the same time they are taking care to stick very closely to facts. The Audiographic Institute, also in Los Angeles, has very recently produced a remarkable documentary film on the problem of the control of atomic energy, called "Where Will You Hide?"

The National Committee on Atomic Information, which was formed by more than 60 national organizations with the cooperation of the Federation of American Scientists, has prepared and distributed printed material, films, recordings, and speeches, and has entered experimentally into practically all phases of public education.

The chief limitation thus far has not been the amount of time which could be spared from teaching and research duties, but the expenses of maintaining an adequate organization. The scientists are not in a position to assume extra financial burdens. The mean age of scientists in the United States is less than 30 years. This is probably also true of those who have assumed active social responsibilities. The young scientist has all the personal problems of other young people, above all, the need for establishing himself in his field to assure future security.

## The Cost of an Expanding Program

At present, a sum of $12,000—$15,000 per month would be sufficient to pay for close to the maximum contribution the scientists can make. But new ideas bring the need for further implementation, create situations where the educator, the radio or film producer, the professional writer, the lobbyist, and dozens of other highly qualified specialists should take over. Once this phase is reached, much larger sums are required. In part, such efforts may depend for their support upon existing institutions and agencies; but the demands of such special projects as international conferences, the testing of materials for teaching in secondary schools, and many others, may in itself easily run into sums several times larger than those needed to secure the time of the scientists.

These then are the possibilities: The Federation of American Scientists, as the nucleus of the scientist movement, may be able to carry out a program which involves self-education on political problems, public education on implications of science and technology, promotion of measures for international good will, and cooperation in the study of international problems wherever this may contribute to averting war. The effectiveness of these activities may be increased many fold by the conscious choice of "chain-reacting" techniques and by the achievement of a minimum financial stability. In this way, scientists and technologists can contribute to the solution of world problems, to an extent far out of proportion to their numbers.

# UNITED NATIONS ATOMIC ENERGY NEWS

**Peter Kihss**

*Mr. Kihss, the representative of the NEW YORK HERALD TRIBUNE at Lake Success, reports negotiations on atomic energy control for the BULLETIN.*

A new effort by middle nations to find a meeting of minds marked the opening of United Nations Atomic Energy Commission work during 1948. But this idea—a Chinese-British-Canadian suggestion that separate conventions outlawing atomic weapons and setting up controls, as the Soviet Union demanded, might be acceptable if their enforcement were coordinated—only met brusque Soviet rebuff.

Of the new nations, Argentina appointed Jose Arce, onetime surgeon, as chief representative, with Rodolfo Munoz, alternate. The Ukraine named Foreign Minister Dmitri Z. Manuilsky as titular chief representative, but in his absence, his alternate, Vassily A. Tarasenko, hitherto counsellor to the Soviet embassy in Washington, attended the sessions. Brazil, which left the commission Dec. 31, designated Alfredo Pessoa, delegation press representative, as observer.

**January 15.** On the eve of the first 1948 sessions, Frederick H. Osborn, American delegate, declared in a Boston speech that "unless world public opinion is freely informed and free to give itself expression, with freedom of access in all countries, the problems of atomic control appear unlikely to be solved."

The Soviet record in the commission, he said, had been marked by (1) initial distrust of others' proposals and submission of a series of counter-proposals; (2) an effort to get concessions from others without yielding anything itself; (3) reversion to its original position, amid bitter denunciation and propaganda attempts to sow discord and arouse suspicion; and (4) steady firming of opposition.

Mr. Osborn saw "little hope for the peace of the world" until the Soviet ended its "intellectual isolation," and he asserted: "It is the task of our generation to take all those steps, including maintenance of our own strength, the economic rehabilitation of others, and the massing of world opinion, which may eventually lead the Soviets to raise the iron curtain and take their rightful part in the comity of nations."

## Committees Discuss Soviet Plan

**January 16.** Working committee began point-by-point study of the June 11 Soviet control plan and elaborations brought out by British-Soviet correspondence later. Point 1 proposed strict international control "simultaneously over all facilities engaged in mining of atomic raw materials and in production of atomic materials and atomic energy," to prevent violations of a convention prohibiting atomic weapons.

Francois de Rose, of France, raised four questions about the scope of international control under the Soviet plan, expressing fear these points were excluded:

1. Since control apparently would begin with mining, does the Soviet believe results of prospecting in various countries should be secret?

2. Since related activities such as production of pure graphite, heavy water and beryllium are intimately linked with atomic energy, the second report had proposed periodic reports on them. Does the Soviet believe international control should apply to them?

3. Would scientific research be internationally controlled in the Soviet plan?

4. Would the Soviet plan provide international control over undeclared activities?

Mr. Gromyko replied that:

1. Control should not extend to activities which were not directly producing atomic materials, since this would "constitute interference in the internal affairs of states," and so related activities should remain "within the competence of individual governments."

2. Prospecting "should be decided by the individual governments and not by the international control agency."

3. Control over secret activities is a separate problem by itself.

4. Governments should have the right to carry out atomic research; but if dangerous amounts of materials are involved, the international agency must apply the same measures it would apply to atomic plants in general.

**January 19.** Control committee took up organizational structure of an international control agency. Mr. Gromyko reiterated that details of organization would be easier once there was agreement on principles, and felt this talk would "waste time." Messrs. de Rose and Osborn observed that the Soviet plan itself had a proposal on composition of the agency—a commission made up of the Security Council nations and Canada.

Canada, France, the United States and Belgium promised to supply experts to describe experience in organizing large-scale enterprises, and Britain proposed to submit experts' papers. But the Soviet Union and the Ukraine declined invitations to do so also. General Andrew G. L. McNaughton, of Canada, regretted the Soviet refusal to supply experts who might indicate the kind of organization important in their minds: "I say to the Soviet Union that through presentation of such ideas there is given to them the very best opportunity to draw our minds to the general principles to be followed."

A working group last summer had studied this problem, but never finally approved or published an August 4 draft paper. This was understood to contemplate a three-level structure—an annual conference of nations signatory to the atomic pact, a fifteen-nation board sitting the year round, and an elected director-general performing actual administration.

Mr. Osborn was appointed deputy American representative to the parallel Commission for Conventional Armaments, and Warren R. Austin, chief representative, wrote him to re-state the view that agreement on effective atomic controls must precede any final accord on other disarmament.

**January 21.** In the first 1948 meeting of the disarmament commission's working committee, Mr. Gromyko rejected as "completely unsatisfactory" an Australian resolution seeking to state general principles. A clause which spoke of disarmament by stages was a vague statement, opening up innumerable loopholes, he said. His experience in the atomic commission showed him "the United States is feverishly looking for loopholes to evade establishment of atomic control." Mr. Osborn said the Soviet delegate didn't appreciate the atomic problem—it is a physical reality, he said, that atomic power can't be produced without producing fuel suitable for atomic bombs.

## The Working Committee Continues Debates

**January 22.** Atomic working committee continued debate on the first Soviet point. Richard T. G. Miles, of the United Kingdom, doubted that the control agency, on the first day of operation, could have the trained personnel and machinery enabling it "to take over in one swoop, as it were, the whole elaborate process of the development of atomic energy." The agency, he said, must work up an effective control system, gradually taking over "this process and that process from the different national agencies," as it becomes more competent.

Mr. Gromyko said: "We cannot imagine the existence of any practical approach to the solution of this question but the simultaneous establishment of control over all such facilities."

Dr. Hsioh-ren Wei, of China, made these points: (1) The major question should be, not one convention or several, but "whether we have one complete control so that the measures shall be applied not only simultaneously but that there will be proper implementation of the various measures of control at the proper time." (2) He wondered whether Soviet proposals for periodic inspection of declared mines and factories, with occasional investigations of suspicious cases, really represented "strict international control." (3) Control should cover prospecting, stockpiles and facilities for development, and clandestine activities.

George Ignatieff, of Canada, said there appeared to be "nothing in the Soviet Union proposals . . . which would indicate that once knowledge was given on the existence of source material in any state, there should be any check other than the survey of the national government."

Mr. Gromyko said the Soviet plan provides for "inspections not only at regular intervals but also in extraordinary cases when there is such suspicion with respect to a certain state or states."

Dr. Wei observed the majority favored "one convention with one complete control," and proposed: "In order to obtain agreement, is it possible to have separate conventions but to have a coordinated enforcement, so that the implementation of the terms will be coordinated?"

Soviet Point 2 proposed an international control commission within Security Council framework. M. de Rose said the term "commission" had "a very special interpretation in the U. N.," being generally used for a body composed of governments or their representatives. He preferred discussing this in control committee.

Mr. Ignatieff said the pith of the question was: "What is the nature of the powers of the proposed commission? Are they to be purely advisory to governments or advisory to the Security Council, or is the commission to have any effective executive functions?"

## Control Committee Discusses Organization

**January 26.** Control committee heard Chester I. Barnard, president of the New Jersey Bell Telephone Company and a consultant in the Acheson-Lilienthal report, as an American expert on organizational structure.

Mr. Barnard proposed a board of eleven directors, elected by the General Assembly as experts rather than national delegates, and a chief executive officer or general manager, appointed by the board, to run the world control agency. The board and manager would be left free to evolve detailed organization, subject to basic treaty provisions on main divisions of work and limitations on authority. They would report and be responsible to the Security Council or General Assembly or both.

Board members should represent a variety of capacities and viewpoints. They should be nominated by "leading states and areas," perhaps eight being nominated by the Security Council members and Canada, and the rest by some other means. Terms should be not less than seven years, with not more than two terms expiring annually. Members should serve full-time during at least the first formative ten or fifteen years of control.

The rest of the organization would report through the executive officer, who need not be an atomic expert, but should have executive experience. Terms of this officer and his chief aids should be at least ten years—in practice, "permanent, subject to competence and good behavior."

In questioning, M. de Rose said studies so far indicated the agency would need research, operation, raw materials and inspection branches. Mr. Barnard opposed the idea of a special annual conference of atomic treaty signatories, seeing danger in multiplication of agencies. But Mr. Miles believed the U. N. might have to contemplate "shareholders' meetings" of signatory nations, and commented the Assembly would probably be busy on non-atomic affairs.

Reporting for the 1947 working group on this problem, Major Jean Ducq, of Belgium, said the group had decided it was premature to re-work the earlier draft until the experts testified. The group felt the agency would have both "executive" organs, formulating directives, and "operating" organs. It wasn't possible at present to propose detailed set-up of operating organs, but the "executive" organs could be studied, and the group invited Soviet participation on this study. There was nothing in the rival Soviet and majority plans which would preclude agreement on this phase. Dmitri V. Skobeltsyn, of the Soviet Union, said the Soviet had not participated in 1947 working groups, which it considered merely drafting bodies, but was willing to participate in this study as preliminary work and an attempt to reach agreement.

January 29. Working committee heard Mr. Miles observe, on Soviet Point 3, that "the inspectorial apparatus is about all the agency will have." M. de Rose said the agency must have other functions. Detailed discussion was left to later linked points.

Point 4 came up, providing for a special control convention "to be concluded in accordance with the convention on the prohibition of atomic weapons." With it was a British question asking if the Soviet would agree that the outlawry pact "shall only come into force following satisfactory implementation of the second convention." The Soviet had answered that the control convention "must be concluded" after conclusion of the prohibition convention.

M. de Rose observed the 1907 Hague convention had prohibited use of poison gas, but such gas was used in World War I and manufactured between the two world wars by "all powers." He said all points should be dealt with simultaneously by a convention.

Mr. Miles recalled the 1925 Geneva protocol, signed by some thirty countries, prohibited both gas and bacteriological warfare. "Nevertheless, there is not a large state in the world that has not conducted active research into the use of these forms of warfare, and the world well knows that it cannot depend on this convention." Prohibition without prevention is useless, he said.

Dr. John D. Babbitt, of Canada, a National Research Council physicist, felt there was room for clarifying the relation between the two Soviet conventions. He asked for a "yes or no" answer to the British suggestion that the prohibition convention should come into force following implementation of the control pact.

### Mr. Gromyko Refuses Overtures

Mr. Gromyko slammed the door: "We consider that the convention on the prohibition of atomic weapons must be not only signed but also put into force before the other convention is concluded." Otherwise, he said, the outlawry pact "would not make sense" and would be "a piece of paper."

Chairman Farris el Khouri, of Syria, asked if this meant destruction of existing bombs before the control pact, too. Mr. Gromyko said it did—within the period specified by the Soviet's June 19, 1946 draft convention proposal, namely, within ninety days after ratification.

Dr. Wei asked if, in case the first convention were carried out and then majority and minority proposals on controls developed: "Will the minority go along with the majority?" He asked if there were any assurance of a second convention. He feared lest the first step become "the last step," and the prohibition pact "meet the same fate—failure—as many previous conventions."

Mr. Gromyko said it had not been the Soviet fault that the commission had not yet found a basis for agreement. The Soviet had pointed out decreases in divergences on "certain minor points," and "then some members of the Atomic Energy Commission did everything possible to widen this divergence of views on certain points, and we could not help coming to the conclusion that probably not all of us are in agreement at the present time at least on carrying out in practice the decision of the United Nations on the establishment of effective international control of atomic energy."

The Soviet delegate added: "Such proposals as were submitted by the United States representative—I have in mind the so-called Baruch plan, which, as far as I know, was not substantially changed later by the United States—are absolutely unrealistic.

"They do not follow from the interests and demands of the establishment of effective international control. They are subordinated to the interests mainly of one country . . . We have to carry out our negotiations on the basis of realistic and practical proposals, and put aside those proposals which prove to be unrealistic and which cannot constitute a basis for agreement."

Chairman Khouri said the commission should not waste further time in "academic discussion," but should prepare both prohibition and control conventions simultaneously, as quickly as possible. "If they were then presented together," he said, "there would, I feel, no longer be any pretext for opposition or contention." He expressed the belief the Soviet would not object to the control convention if it were presented and put into force at the same time as the prohibition convention.

## Physics in the Contemporary World

(*Continued from Page 68*)

that not only what the scientist finds but how he finds it is worth learning and teaching and worth living through.

Yet there is something fake about all this. No one who has had to do with elementary instruction can have escaped a sense of artificiality in the way in which students are led, by the calculations of their instructors, to follow paths which will tell them something about the physical world. Precisely that groping for what is the appropriate experiment, what are the appropriate terms in which to view subtle or complex phenomena, which are the substance of scientific effort, almost inevitably are distilled out of it by the natural patterns of pedagogy. The teaching of science to laymen is not wholly a loss; and here perhaps physics is a typically bad example. But surely they are rare men who, entering upon a life in which science plays no direct part, remember from their early courses in physics what science is like or what it is good for. The teaching of science is at its best when it is most like an apprenticeship.

President Conant, in his sensitive and thoughtful book, *On Understanding Science*, has spoken at length of these matters. He is aware of how false it is to separate scientific theory from the groping, fumbling, tentative efforts which lead to it. He is aware that it is science as method and not as doctrine which we should try to teach. His basic suggestion is that we attempt to find, in the history of our sciences, stories which can be recreated in the instruction and experiment of the student, and which thus can enable him to see at first hand how error may give way to less error, confusion to less confusion, and bewilderment to insight.

The problem that President Conant has here presented is indeed a deep one. Yet he would be quite willing, I think, that I express skepticism that one can recreate the experience of science as an artifact. And he would no doubt share my concern that science so taught would be corrupt with antiquarianism. It was not antiquarianism, but a driving curiosity, that inspired in the men of the Renais-

sance their deep interest in classical culture.

For it is in fact difficult, almost to the point of impossibility, to recreate the climate of opinion in which substantial errors about the physical world, now no longer entertained, were not only held but were held unquestioned as part of the obvious mode of thinking about reality. It is most difficult to do because in all human thought only the tiniest fraction of our experience is in focus, and because to this focus a whole vast unanalyzed account of experience must be brought to bear. Thus I am inclined to think that with exceptions that I hope will be many, but fear will be few, the attempt to give the history of science as a living history will be far more difficult than either to tell of the knowledge that we hold today, or to write externally of that history as it may appear in the learned books. It could easily lead to a sort of exercise of mental inventiveness on the part of teachers and students alike which is the very opposite of the candor, the "no-holds-barred" rules of Professor Bridgman, that characterize scientific understanding at its best.

If I am troubled by President Conant's suggestions, this is not at all because I doubt that the suggestions he makes are desirable. I do have a deep doubt as to the extent to which they may be practical. There is something irreversible about acquiring knowledge; and the simulation of the search for it differs in a most profound way from the reality. In fact, it would seem that only those who had some first-hand experience in the acquisition of new knowledge in some disciplined field would be able truly to appreciate how great the science of the past has been, and would be able to measure those giant accomplishments against their own efforts to penetrate a few millimeters further into the darkness that surrounds them.

Thus it would seem at least doubtful that the spiritual fruits of science could be made generally available, either by the communication of its results, or by the study of its history, or by the necessarily somewhat artificial reenactment of its procedures. Rather it would seem that there are general features of the scientists' work, the direct experience of which in any context could contribute more to this end. All of us, I suppose, would list such features and find it hard to define the words which we found it necessary to use in our lists. But on a few, a common experience may enable us to talk in concert.

In the first instance the work of science is cooperative; a scientist takes his colleagues as judges, competitors and collaborators. The work of science is disciplined, in that its essential inventiveness is most of all dedicated to means for promptly revealing error. One may think of the rigors of mathematics, and the virtuosity of physical experiment as two examples. Science is disciplined in its rejection of questions that cannot be answered, and in its grinding pursuit of methods for answering all that can. Science is always limited, and is in a profound sense unmetaphysical, in that it necessarily bases itself upon the broad ground of common human experience, tries to refine it within narrow areas where progress seems possible and exploration fruitful. Science is novelty, and change. When it closes it dies . . . These qualities constitute a way of life which of course does not make wise men from foolish, or good men from wicked, but which has its beauty and which seems singularly suited to man's estate on earth.

If there is to be any advocacy at all in this talk it would be this—that we be very sensitive to all new possibilities of extending the techniques and the patterns of science into other areas of human experience.

## The Scientific Approach and Social Problems

We become fully aware of the need for caution if we look for a moment at what are called the social problems of the day, and try to think what one could mean by approaching them in the scientific spirit, of trying to give substance, for example, to the feeling that a society that could develop atomic energy could also develop the means of controlling it. Surely the establishment of a secure peace is very much in all our minds. It is right that we try to bring reason to bear on an understanding of this problem; but for that there are available to us no equivalents of the experimental techniques of science. Errors of conception can remain undetected and even undefined. No means of appropriately narrowing the focus of thinking is known to us. Nor have we found good avenues for extending or deepening our experience that bears upon this problem. In short, almost all the preconditions of scientific activity are missing, and in this case, at least, one may have a melancholy certainty that man's inventiveness will not rapidly provide them. All that we have from science in facing such great questions is a memory of our professional life, which makes us somewhat sceptical of other people's assertions, somewhat critical of enthusiasms so difficult to define and to control.

Yet the past century has seen many valid and inspiring examples for the extension of science to new domains. One feature which I cannot fail to regard as sound—particularly in the fields of biology and psychology—is that they provide an appropriate means of correlating understanding and action, and involve new experimental procedures in terms of which a new conceptual apparatus can be defined; above all, they give us means of detecting error. In fact, one of the features which must arouse our suspicion of the dogmas some of Freud's followers have built up on the initial brilliant works of Freud, is the tendency towards a self-sealing system, a system, that is, which has a way of almost automatically discounting evidence which might bear adversely on the doctrine. The whole point of science is to do just the opposite: to invite the detection of error and to welcome it. Some of you may think that in another field a comparable system has been developed by the recent followers of Marx.

Thus we may hope for an ever widening and more diverse field of application of science. But we must be aware how slowly these things develop, and how little their development is responsive to even the most desperate of man's needs. For me it is an open question, and yet not a trivial one, whether in a time necessarily limited by the threats of war and of chaos, these expanding areas in which the scientific spirit can flourish may yet contribute in a decisive way to man's rational life.

I have had to leave this essential question unanswered: I am not at all proud of that. In lieu of apology perhaps I may tell a story of another lecturer, speaking at Harvard two decades ago. Bertrand Russell had given a talk on the then new quantum mechanics, of whose wonders he was most appreciative. He spoke hard and earnestly. And when he was done, Professor Whitehead, who presided, thanked him for his efforts, and not least for "leaving the vast darkness of the subject unobscured."

# OPINIONS ON ATOMIC ENERGY FROM THE NETHERLANDS

**We reprint excerpts from a communication to the British Atomic Scientists News Letter from Professor M. Minnaert of Utrecht, distinguished astrophysicist and President of the Dutch Association of Scientific Workers.**

In our country, just liberated after heavy suffering, only reluctantly did people turn to worrying again about all the calamities which might threaten us in the near future. Even at our universities very little has yet been done to inform the intelligent citizen about the problems connected with atomic energy.

A number of lectures are now being organized for students, university extensions and intellectual centres all through the country. The basic ideas which we develop in these lectures may be summarized thus: Control is necessary, control is possible, and scientific workers must play an important role in convincing the world of the need for it.

I will try to point out the general trend of thought [on problems of atomic energy] which is found among most of our scientists.

Nobody is in doubt about its scientific and military importance, but conservative opinion is rather sceptical about the possibility of energy generation for technical purposes. There are also a number who contend that so many new methods may be discovered that it is impossible at present to set limits to future progress. Clearly, such a development of atomic energy can only be made, if at all, by the effort of a big country with great scientific and technical resources. Therefore, measures should be taken immediately to prevent economically feeble nations becoming dominated by powerful countries which are ahead in atomic research. Moreover at this moment, when perhaps an important new source of wealth and welfare is being discovered by mankind, we should try to make its benefit available to everyone, rather than keep it for a restricted capitalist class.

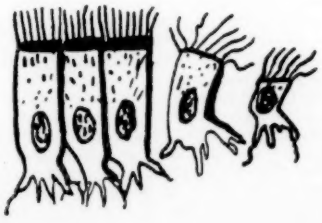
Practically all of us advocate international control. But we are well aware that this control will only come into existence if an agreement is reached between the two great powers America and Russia.

Generally speaking, and so also in the question of atomic energy control, the Dutch public, and the scientists also, have *a priori* more sympathy for America than for Russia. But nevertheless there is a belief that the American and the Russian proposals have each some definite advantages, and that discussion in the Atomic Energy Commission is therefore extremely useful, and much preferable to a one-sided choice or to simple approval of one of the plans. Some American and British newspapers are complaining about "the complete defeat of all negotiations," because they consider any deviation from their own plan as incomprehensible and mischievous. But if we study the Lilienthal-Acheson report, The Chicago Amendment, the Baruch plan, and the successive Russian declarations, we find that the official Baruch plan is in several respects poorer than the Lilienthal Report or the Chicago Draft; and we notice that the Russians have made important concessions since their first declarations.

It has been shown by various authors that suppression of the right of veto is by no means essential for making the [atomic energy] control effective; as a matter of fact, it was not included in the original Lilienthal report.

The Lilienthal report gave to this international body a practically monopolistic power in all "dangerous" operations: mining, purifying the ores and separating U-235 or Plutonium. It is clear that this plan afforded by far the most complete guarantee against misuse.

Generally speaking, we believe that we can understand fairly well the motives which are at the bottom of the two rival proposals. We think that they have sufficient in common to make an agreement possible. It would seem to us that small countries like Holland have the task of reconciling the different views of the great powers and of urging their governments to come to an agreement as quickly as possible.



**The following statements are part of a resolution passed at a convention of The Society of Calvinist Lawyers and The Christian Society of Scientists and Physicians in The Netherlands in November, 1947. Although these societies represent only about four percent of their professions, they have an intellectual influence on the large Protestant population of Holland, far greater than this figure implies.**

The development of atomic energy can, beside other forms of production of energy, be of considerable importance to economic life. It may, by its direct and indirect consequences, contribute to the physical and social welfare of mankind.

Cooperation towards development of this valuable asset of culture is therefore justified.

The atomic weapon itself does not bring about an essential change in warfare. However, the extent of its destructive power is so great that it is not possible to restrict the force of arms to purely military objects.

On account of this exceptional character, international control and inspection of the atomic weapon is imperative.

Prohibition of the atomic weapon without international control must be rejected as absolutely inefficient in view of former experience with similar prohibitions.

Application of atomic energy for peaceful purposes leads inevitably to the possibility of preparing for military applications.

On this ground also the production and use of atomic energy for peaceful purposes come within the sphere of international law, and should be put under supervision and inspection of an international organization.

National sovereignty is not a legal ground for rejecting international control of the atomic energy.

# THE ATOMIC ENERGY COMMISSION REPORTS TO THE CONGRESS

**On January 31, the Third Semiannual Report of the United States Atomic Energy Commission, signed by its five members, was submitted to the Congress. The editors present a condensed version of this report.**

## I: A SUMMARY OF THE FIRST YEAR

In its first report to the Congress a year ago, within the month of the transfer of the Atomic Energy Program from military to civilian management, the Atomic Energy Commission outlined its organizational policies and general plan. In July, 1947, the Second Semiannual Report to the Congress reviewed the preparations for the long-term program and reported briefly on the program for expansion of the project.

The following pages are a summary of the first year of operation under legislative authority of a project in which the American people have invested heavily of funds and hopes.

The Joint Committee on Atomic Energy provides the means for informing the Congress of matters the open discussion of which might be prejudicial to the security of the United States. In this public report, we have attempted to provide sufficient unclassified information to permit general appraisal of the progress of the Nation's atomic energy business.

During 1947, there was progress toward the repair of administrative and physical erosion which resulted from the uncertainty following the cessation of hostilities of World War II.

The paramount objective of "assuring the common defense and security," required a major program of development at the Los Alamos Scientific Laboratory, where the weapons program is concentrated. An over-all plan was completed and a number of steps taken towards its fulfillment, including the construction of service and technical facilities, improvement and standardization of weapon components, work on new designs, and the beginning of an extensive program of stabilizing production.

The work progressed to a point permitting field tests of results at a Proving Ground established on Eniwetok Atoll.

The production of fissionable materials was maintained. A general program for expansion was started along four main lines:

1. Through development of new sources of raw materials.
2. Through improvement of processes for the reduction of ores and preparation of food materials.
3. Through renovation and expansion of existing facilities for the production of fissionable materials, and advances in operating techniques.
4. Through the development of the nuclear reactor for more efficient utilization of fissionable material.

A major program of expansion and improvement of the Hanford plant for plutonium production was started in the fall of the year.

Research, both applied and fundamental, was reorganized and expanded.

More than 100 research contracts or subcontracts were in effect during 1947 and a $90,000,000 plan for the provision of new research facilities was inaugurated. The major accomplishment in 1947, however, was the consolidation of programmatic research projects and the establishment of a research policy designed to utilize the full scientific potential of the nation.

The production of radioisotopes at the Clinton National Laboratory made possible a nation-wide tracer research in medicine, agriculture, biology, metallurgy, and industrial processing. The Commission does not report on the work done by the agencies (nearly 200 public and private institutions) using this research tool.

The Commission established a Division of Biology and Medicine. By year's end, the Division had completed an industrial hygiene survey and laid plans for improvement in health protective measures; developed a program for the training of scientists and technicians in medical, biological, and health physics fields; arranged for the operation of two medical and biological training centers to be established by the Commission; and completed plans for support of cancer research.

The security of the project has been strengthened by the establishment of special guard forces, installation of new equipment, and more adequate controls of classified materials. The Federal Bureau of Investigation has completed more than 40,000 personnel investigations of "character, associations and loyalty," as required by the Act. A Personnel Security Review Board headed by former Supreme Court Justice Owen J. Roberts, was appointed.

The dissemination of data necessary to the growth of American science was continued under the system of declassification established in 1946. A technical information service for the Commission and contractor organizations was established, and public information service was provided. The availability of security guidance to these media has been helpful in maintaining the security of information.

In appraising the program, it should be recognized that the basic structure is determined by the physical plant built during the war to accomplish the single objective of developing and producing a weapon in the shortest possible time, and by the plans initiated by the Manhattan Project prior to the passage of the Atomic Energy Act of 1946, including the establishment of the Knolls Atomic Power Laboratory and the broad National laboratories program.

## II: RAW MATERIALS

The Commission established in October a Division of Raw Materials. A group of eight mining men was appointed as an Advisory Committee on Mining and Exploration (Donald H. McLaughlin, president, Homestake Mining Company, Lead, South Dakota, chairman).

The supplies of source material have come predominately from certain foreign countries; in the United States only recovery of by-product uranium from the vanadium industry of the Colorado Plateau was feasible during the war. The Commission now must plan for future unpredictable demands for uranium.

One of the objectives of the Division of Raw Materials is to determine the uranium resources of the United States. A solution to the problem is not confined to the discovery of ore reserves. Equally important are improvement in the refining and recovery processes, development of more efficient reactors, utilization of uranium in materials which now go from the various stages in the process to storage. Intensive research is directed toward these goals.

### Domestic Resources

The first appraisal of domestic reserves of uranium was undertaken during the war by the Manhattan Engineer District.

The program included refining of current and accumulated residues from vanadium mills at Durango, Uravan, and Naturita, Colorado, and Monticello, Utah. Following the war, the government-owned facilities for treating tailings were dismantled by the Manhattan Engineer District, and government-owned plants for processing vanadium ores were declared surplus. Privately-owned plants curtailed or suspended operations. The only operations at the present time are those sustained by government purchases of vanadium and uranium.

Deposits of very low-grade ore, discovered during the war, are now being studied from the point of view of recovery of their uranium content. Their utilization depends upon the solution of difficult research and industrial problems. Exploration for additional deposits is continuing.

The Commission believes new reserves of source materials can best be developed by competitive private industry, and the means of accomplishing this are under study.

The Commission's general policy is to purchase ores from private sources and limit direct government production as far as possible. It is desirable, however, for the Commission to carry on certain activities for the purpose of determining the most efficient methods of ore extraction and beneficiation. The Commission recently purchased the vanadium plant at Monticello, Utah, from War Assets Administration and plans to put it into operation after necessary alterations have been made and an ore stockpile accumulated. Consideration will be given to operation or encouraging the operation of other plants in the area. A raw materials office has been opened at Grand Junction, Colorado.

The scope of the ore buying program to be recommended will be determined after full consideration of the raw materials picture, now under way.

## III. PRODUCTION

Production operations account for about 70 percent of construction expenditures and about 80 percent of operating expenditures. A public report can reflect only those phases of the effort which do not reveal operating information. While restrictions on information are justified and will be maintained, effective security really depends upon technological advancement and production achievement.

Processing of source materials at the point of extraction from the earth is under the direction of the Division of Raw Materials. Subsequent steps, through the reduction to metal and the preparation of feed materials, the separation of fissionable isotopes, production of fissionable materials in reactors, the separation of radioactive materials, and the manufacture of components of weapons is coordinated through the Division of Production.

Experience gained in the processing of source materials has been reflected in improved quality and increased efficiency. The program is demanding an ever-increasing output, but unit costs have been reduced.

The organization is designed to maintain production at maximum levels and to insure against contingencies which might reduce the flow of materials to isotope separation plants and production reactors. Certain residue materials potentially valuable for other purposes are stored for possible additional processing.

### Production of Fissionable Materials

In 1946, the Manhattan Project began to reduce operations at the Oak Ridge Electromagnetic Isotope Separation Plant and to increase production at the Gaseous Diffusion Plant. While much of the equipment in the Electromagnetic Plant is maintained in standby condition, its powerful magnets and research facilities are used for limited production and process improvement.

Plutonium is produced at Hanford, where facilities are being substantially expanded, taking into account both new developments and the normal deterioration of facilities. The plant additions at Hanford, with necessary residential, administrative, and other auxiliaries constitute one of the largest construction programs ever undertaken by the Government in peacetime.

The General Electric Company, operator of the Hanford Works and prime contractor for the construction program, has mobilized a strong technical and construction group and organized the procurement of the many nonstandard items of equipment needed. Assembly is now under way.

Since the materials used in the production process must be of a purity never before achieved outside the laboratory, an elaborate quality control and specification testing is necessary. The more difficult tests are performed in laboratories of the Commission, the National Bureau of Standards, or in cooperating universities. A great variety of new instruments has been developed for these purposes and for the detection of radiation, which are now proving useful in other industries and laboratories.

### Production of Weapons and Isotopes

The atomic weapons produced during the war were laboratory products, experimental devices not only designed but also largely fabricated and assembled by the scientists who conceived them at Los Alamos. With the ending of the war came an interval of readjustment during which weapon development was carried on under very difficult conditions. It became clear that for the longer-term operation, a much broader base for operations was needed to insure against "bottlenecking" at any stage.

During its first year, therefore, the weapon program was directed toward converting from unit fabrication to a different scale of weapon production. This necessitated basic changes in organization and planning including:

Expansion of production facilities, to effect a continuous flow of component parts.

Development of new designs, stemming partly from work done during the war.

Improvement and standardization in the design of component parts.

Standardization of procedures—and provision of standard instructions—for storage and handling. Progress is being made towards these objectives.

Active isotopes for off-project distribution are produced at Oak Ridge. The stable isotopes are separated in the magnetic machines built during the war to extract U235 from common uranium. The radioactive isotopes are manufactured by irradiation of materials in reactors constructed for the production of plutonium. Thus, isotopes are by-products of the manufacture of the atomic bomb.

If the development of atomic energy had produced nothing else, its cost would have been balanced within a few years by the gains in knowledge that the nation is making with isotopes—in medicine, chemistry, industry, and agriculture. The Commission's aim is to make isotopes available to all qualified users in quantities as large as can be profitably used, in variety as great as can be developed, and at the lowest possible cost.

Nearly 2,000 shipments of radioactive isotopes have been made since August, 1946. Close to 100 different kinds are available, and it is certain that all reasonable future demands can be met. Costs for most types are now well within the range that the average laboratory can afford to pay. The Commission provides advice on the utilization of radioactive isotopes, together with film badges and other safety equipment.

In September, 1947, the President announced a program of foreign distribution of isotopes. Twenty varieties, particularly those most important for biological and medical research, are now available in limited quantities to foreign laboratories upon prior agreement by the recipients to make six-month reports to the Commission on results obtained and permit publication of such results; to use the isotopes only for purposes stated in the original requests; and to permit qualified scientists of all nations to visit their institutions and freely obtain information in accordance with scientific tradition. Twenty shipments have been made to Argentina, Australia, Denmark, and the United Kingdom. Future shipments to Belgium, Canada, Cuba, France, Ireland, Italy, the Netherlands, New Zealand, Peru, Sweden, and the Union of South Africa have been approved.

Development work in the electromagnetic separation plant made available more than 100 types of stable isotopes for distribution in the United States, and some 200 shipments were made in 1947. A new Committee on Isotope Distribution (D. G. Failla, Chairman) was named to advise the Isotopes Division on distribution, particularly where therapeutic treatment was planned.

## IV: RESEARCH AND DEVELOPMENT

Great progress has been made toward reorganization of the atomic energy research program in accordance with the following requirements:

1. Concentration of available facilities and personnel on the most urgent problems.
2. Support of fundamental research to restore the level of activity reduced since before the war.
3. Utilization of the national research potential, governmental, academic, and industrial.
4. Expansion of research personnel.

## Programmatic Research:

### Raw Materials

A research program was designed to assist in the exploration for ore deposits, improvement of the recovery methods, and develop methods for beneficiating low-grade ores. Exploration research includes investigations to determine the origin of various deposits, and radiometric work to develop improved methods for exploration and laboratory procedures. The development work includes the operation of plants at the ore sources, one of which is now working in the Colorado Plateau region on the extraction of uranium from low-grade carnotite.

Tightening of specifications for feed materials used in reactors requires study of the properties of these materials, the methods of their refinement, and the means of improving quality of the final product.

One of the main phases of research in chemistry and chemical engineering is the development of improved methods for fissionable material separation and purification. Current emphasis is on the development of improved methods of plutonium separation, and on a system for the recovery of fuel materials from reactors now in the design stage.

### Weapons Research

Problems relating to atomic weapons research and development are dealt with mainly at Los Alamos. The principal goal is the scientific and engineering perfection of designs. The past year has seen definite progress towards this goal.

Testing of weapons and components under simulated operation conditions is necessary to improved design. The procurement of materials and the installation of facilities are well under way at Eniwetok Atoll Proving Ground. The operations of the proving ground will provide broader understanding of the phenomena of nuclear fission for peaceful as well as military application.

The major part of the construction program has been undertaken by the Armed Forces. Full security restrictions are in force, and only participating officials are permitted. The Security Council of the United Nations has been informed by the U.S. Department of State, which also officially notified representatives of other nations.

### Reactors

The work on nuclear chain reactors is shaped by three considerations:

a. Requirements of the Military Establishment.

b. Reactors for research and development purposes.

c. Special and large-scale industrial applications.

The work aimed at these purposes does not separate, even though the principal objective may be quite distinct.

The requirements of the Military Establishment involve reactors to provide fissionable materials, and reactors for military power requirements. Industrial applications may be for the generation of electric power, for the production of high temperature heat, and for special purposes such as irradiation of materials. This report covers for the most part work on problems common to all reactors, regardless of purpose.

The *working materials* in the construction of reactors fell into six categories: Fuel elements, moderators (required in reactors utilizing neutrons of low energy), coolants, structural materials, shielding (to confine the radiation), and auxiliaries, such as pipes, valves, blowers, pumps, instruments and controls, feeding and removal mechanisms, and protective casings for feed materials.

The specifications for all materials to be used cover neutron absorption characteristics, resistance to corrosion, chemical and physical stability under high temperature and intense radiation, and workability into shapes which will withstand high internal and external stresses.

Sufficient progress has been made to permit the design of medium high temperature reactors using various coolants and moderators, operated at temperatures high enough to produce power on an experimental basis. One of such should be in operation by the end of 1950, and perhaps earlier.

Studies of *reactors for military power requirements* are presently carried out by the Department of the Air Forces and by the Department of the Navy, with the Commission's cooperation.

Many of the problems encountered in finding the working materials for new reactors involve the use of reactors for testing. In addition to Hanford reactors, the Commission has available two reactors at Los Alamos, two at Argonne National Laboratory, and one at Oak Ridge.

These reactors are excellent for the purposes for which they are used: to produce plutonium, to produce isotopes, and for research. No one of them produces usable power and no one of them operates at a high temperature. The "fast" reactor at Los Alamos uses plutonium as fuel. The others are uranium reactors, operating at relatively low temperature.

Construction was started this year on a uranium, graphite-moderated, air cooled reactor for research purposes at Brookhaven National Laboratory. Basically similar to the existing reactor at Clinton National Laboratory, the new Brookhaven reactor will be somewhat more powerful. It should be in operation within a year.

Argonne National Laboratory is nearly ready to start construction of a new type of reactor, operated at temperatures sufficiently high to make possible production of useful power.

A reactor similar in purpose to the new Argonne reactor but of different design at the Knolls Atomic Power Laboratory at Schenectady will provide further information on coolants and permit special studies of both components and power production.

Clinton National Laboratory has carried to an advanced stage the design of a high-flux reactor for general research and development purposes. The specification calls for a neutron intensity far greater than is now available and will include provisions for testing reactor components at high temperatures. It will be constructed at Argonne National Laboratory.

General power reactors have been studied at Clinton National Laboratory. The studies completed thus far constitute an important store of knowledge of the power problem and particularly of components and auxiliaries.

### "Breeding"

Underlying the entire field of atomic energy is the problem of the availability of fissionable materials. This availability depends not only on the stores in the earth's surface, but on the time and energy consumed in obtaining them in quantities sufficient to permit full scale development of atomic energy.

Solution may lie in one or several directions: 1) discovery of new deposits; 2) improvement of recovery processes; 3) development of new recovery processes for different types of source material; and 4) more efficient utilization of the available fissionable material.

One important line of work is the development of a "breeder," a reactor which will create more fissionable material than is put into it as fuel.

The word fuel denotes here the fissionable material put into the reactor as the source of energy and of neutrons on which the fission process depends. The material which is put into the reactor for conversion into fissionable material is known as fertile material. If more fissionable material is produced from the fertile material than is consumed as fuel, there would be a net gain or a "breeding" of the fuel.

The significance of the breeder type of reactor is related to questions of the stores of uranium and thorium in the earth's surface and the economic, political, and technological problems of their recovery. Both the military and industrial potential of atomic energy justify the effort to solve the problems of "breeding."

The accumulation of fuel through operation of a breeder may be likened to the compounding of interest on money. The initial stock of fuel can be compared to the capital which the depositor puts into a savings account. That capital—in this case fissionable material—is put to work producing power. But at the same time, additional fissionable material (interest on the capital) is accumulating and increasing the original capital.

### Power

There is a complete interlocking of the scientific and engineering problems of the breeder and the *power reactor*, with both heavily influenced

by our ability to procure, recover, and process efficiently and with reasonable economy the required fuels.

The development work to be done in these fields and the periods of time required to produce usable amounts of new fuel through "breeding," introduce a time factor measured in years into any discussion as to when nuclear energy can make a significant contribution to the supply of power.

It was with these facts in mind that the Chairman of the Commission expressed the Commission's views that a common estimate of the time schedule for the development of nuclear power "is from eight to ten years to overcome the technical difficulties and have a useful, practical demonstration plant in operation."

In a recent paper the General Advisory Committee said: "Assuming even a most favorable technical development, we do not see how it would be possible to have any considerable portion of the present power supply of the world derived from nuclear fuel before the expiration of twenty years."

## Facilities for Basic Research

Basic research is carried on in AEC facilities as well as in other government and university laboratories. AEC laboratories conduct all basic research involving reactors.

Arrangements are being made with the Office of Naval Research for joint sponsorship of a program which will insure efficient utilization of facilities, personnel, and results.

Basic research was expanded during 1947 in the fields of physics, chemistry, and metallurgy. It included studies of nuclear properties of elements important to reactor, weapon, and other work; the chemistry of the transuranic elements and of radioactive materials; and the metallurgy of both fuel elements and reactor working materials.

Basic studies of the interaction of elementary particles are being done chiefly through the use of particle accelerators.

The principal facilities where basic work is under way are: Argonne National Laboratory, Batelle Memorial Institute, Brookhaven National Laboratory, Clinton National Laboratory, Columbia University, Iowa State College, Massachusetts Institute of Technology, Radiation Laboratory, University of California, United States Bureau of Standards.

*Nuclear Reactions Investigated in Cyclotrons.* The 184-inch cyclotron at the Radiation Laboratory, University of California, has provided a source of alpha particles and deuterons with which to investigate nuclear structure. So-called "spallation" or splintering reactions, have been observed, in which as many as fifteen primary particles have been ejected from a single nucleus.

Fission was induced in certain heavy nuclei by high energy alpha particles and deuterons, and has been observed in bismuth, lead, thallium, platinum, and tantalum.

The cyclotron experiments have confirmed the existence of "exchange forces" between protons and neutrons and thus made a step toward answering the question of what holds the nuclear particles together.

A new *linear accelerator* was built at the University of California and operated to produce protons with an energy of 32 million electron volts.

*Research Reactors.* New radioactive substances and concentrated beams of neutrons are produced in the nuclear reactors now available at Oak Ridge, Los Alamos, and Chicago. Such products are now indispensable to fundamental investigation. New experimental reactors—especially the one at the AEC Brookhaven Laboratory—will further expand the area of basic research with neutron beams.

*Trans-Uranic Elements.* Chemists in the Commission's laboratories are studying the newly created elements such as neptunium, plutonium, americum, and curium.

*Rare Earths.* The rare earth elements have been practically unavailable except as mixtures. The development of methods for chemical separations of radioactive isotopes has found a successful application in the field of rare earth separation.

*Synthesis of Labeled Organic Compounds.* Radioactive Carbon-14 has been available for the last year through the Isotopes Division of the Commission. It is now available also for foreign distribution.

To be useful in research, the radioactive carbon must be incorporated into molecules to undergo the organic reactions under study. Many labelled organic compounds suitable as starting materials have been synthesized in the Commission's laboratories, and are being used to study various biological problems and to investigate the exceedingly important plant process of photosynthesis. It is expected that several such compounds will be available soon for distribution. One, labelled methanol, is currently being distributed.

*Publications.* One measure of the contribution to basic research is the volume of publications and reports which have been issued. Current work is covered in nearly 3,000 reports. The subjects embrace many fields of interest excepting only those aspects of atomic energy research that cannot be discussed publicly at the present time.

# V: BIOLOGY AND MEDICINE

During its first year of operation, the Commission laid the groundwork for a program of biological and medical research and education.

In June, 1947, the Commission requested the President of the National Academy of Science to nominate a panel of advisers to review the medical and biological aspects of the program. This Medical Board of Review recommended the expansion of research and training, appointment of a permanent advisory group, and establishment of a broad training program.

A permanent advisory committee for biology and medicine was appointed in September, 1947, and convenes at monthly intervals at the various installations.

A division of biology and medicine was established within the Washington headquarters. It will correlate the medical and biological research programs in government, and in private laboratories; initiate investigations and review all contracts and allocations of funds for research; and direct the Commission's health physics work and industrial hygiene activities.

## Cooperation with Other Agencies

Arrangement was made with the National Research Council for joint sponsorship of the Council's Committee on Atomic Casualties which will make a long-range study of the effects of atomic bombing on survivors in Hiroshima and Nagasaki. Besides the effects on general physiological functions, the relations of genetics and cancer are primary concerns.

Production and distribution of isotopes for medical and biological investigations were developed and a Committee on Isotopes Distribution composed of experts in the field was appointed.

Organization of the Office of Naval Research was supported. A fellowship program for training for atomic energy work in medical and biological fields was prepared. (See Section VII)

A Cancer Program was formulated in accordance with the policy of assisting established medical research to explore the application of atomic energy to cancer treatment. Assistance was given to such institutions as the New York Memorial Hospital, Harvard University, and the University of California; in the Commission's laboratories, radioactive materials for cancer treatment were developed; beds for cancer patients were provided in hospitals at the Clinton, Brookhaven, and Los Alamos Laboratories. Funds for medical and biological training and research center at the University of Rochester were authorized.

The Commission's contracts with the University of California, Columbia University, Harvard University, the Massachusetts Institute of Technology, and the University of Rochester provide for research not only on the biological effects of radiations but also in the utilization of isotopes for the investigation of life processes in plants and animals.

At the Clinton National Laboratory, studies were carried out on the effects of atomic energy on hereditary traits. At the Argonne National Laboratory, toxicologic studies on the various products of fission were continued. This study revealed new methods of producing tumors and thereby provided new avenues in cancer research.

At Los Alamos, several drugs and vitamins were made radioactive and studied in the human body.

### Measures for Industrial Health

Unprecedented safety measures have been developed to meet the hazards to health involved in the atomic energy production process.

Many of the materials that must be handled are organically poisonous, aside from any danger of radiation. Investigations of why the materials are toxic and determination of tolerance standards have resulted in more effective protective clothing, respirators, dust removing systems, cleaning methods, and analytical techniques of testing.

Investigations of the effects of radiations on living things still have the character of a search after fundamental knowledge. Therefore, safety measures against radiation lack well-established standards. The policy has been to take no chances. A small fraction of the tolerance dose has been the limit for workers. Shielding has been designed with ample safety factors.

The Offices of Directed Operations maintain Medical Divisions to coordinate safety operations in contractors' plants. A remarkable safety record has been achieved in 1947 throughout the organization. (See Section IX)

## VI: ENGINEERING AND CONSTRUCTION

Construction and engineering represents a very large proportion of expenditure in the current program. In early 1947 there were broad program determinations and detailed planning. Actual new construction got under way in the summer of 1947. Production plants are taking by far the largest share of construction effort.

A large share of all construction was at Hanford in preparation for the building of new production facilities. New storage facilities for process materials were completed. A $14,000,000 permanent housing project was about one-fifth completed.

The new Metallurgy Building at Iowa State College at Ames, for the study of production of uranium and thorium is about half complete. Another project brought close to completion is a developmental laboratory at Miamisburg, Ohio. In the Radiation Laboratory of the University of California, a new synchrotron is under construction.

At the Knolls Atomic Power Laboratory at Schenectady, a $15,000,000 construction program is 10% complete. A 70,000-square-foot building was converted to the use of laboratories, shops, and offices previously crowded in the General Electric plant.

Los Alamos, which now has a permanent population of 8,000, was built during the war in an isolated and physically confined area. Living conditions are far below the standard acceptable, on a long-term basis, to the scientists and other workers; maintenance costs of the hastily constructed community are abnormally high. During 1947, an emergency program of renovation was pushed with all possible speed.

At Oak Ridge, population 35,000, a construction program to provide public works, safety installations, and school facilities was about 60% completed.

Engineering and design of facilities to be constructed in 1948 went ahead. More than a score of major plans were developed to the stage where actual construction would soon begin.

The construction project at Hanford is big by any peacetime—or wartime—standards. Contracts were let for the enlargement of electric power and telephone facilities; plans were completed on projected railroad and highway connections, both of which will bridge the Yakima River. Heavy construction equipment sufficient to meet 80% of future needs was obtained from Government agencies. About $5,000,000 worth of building materials and equipment was obtained from the War Assets Administration and about $11,000,000 worth from the Army, Navy, and Department of the Interior.

The expanded production program at Los Alamos will require the expenditure of more than $23,000,000 during the next fiscal year.

Plans were well advanced in 1947 for construction of the National Laboratory establishments at Argonne, in DuPage County outside Chicago, and Brookhaven, on the site of the former Camp Upton at Patchogue, Long Island. Contracts were let, and design carried to an advanced stage.

At Brookhaven, ground was broken in August, 1947, for the construction of an experimental reactor. Design of the reactor was completed, and construction begun. Design of laboratory buildings was completed.

The contract for the design and construction of the Argonne National Laboratory was let in May, 1947, to the University of Chicago. Actual construction is scheduled to begin in the Spring of 1948.

### Housing and Community Needs

Community development at Oak Ridge involves long-term planning, for a city of 35,000 people or more. The Commission in 1947 started the preparation of a master plan. The plan has four phases: the preparation of maps showing present utilization; analysis of present utilization; development of plans for improved utilization; and finally, the development of definite plans covering zoning, transport, utilities, recreational features, and other necessities.

Similar studies were started at Hanford and Los Alamos. A 114-bed community hospital, for Los Alamos, was approved by the Federal Bureau of Hospitalization. The hospital will have a wing set aside for medical research, where cancer patients will be provided with care and treatment without charge, as part of one of the Commission's cancer research programs.

## VII: TRAINING AND INFORMATION

During 1947, a Fellowship Program was developed in the Division of Biology and Medicine. The Commission will finance the program and establish the training goals. Administration, including selection of candidates, will be undertaken by the National Research Council of the National Academy of Sciences. The AEC has budgeted approximately $1,000,000 for the first year.

The initial fellowships will be distributed among Doctors of Medicine, Doctors of Philosophy in the biological sciences, and Bachelors of Science and of Arts, who will receive training in health physics and related subjects. Post-doctoral fellowships will extend for two years, and graduate training in health physics for one year or longer. A similar plan for research fellowships in the physical sciences is under development.

### The National Laboratories

The Atomic Energy Act makes the Commission responsible for: "a program of assisting and fostering private research and development, and ..."a program of federally conducted research and development..."

To some extent these objectives are being pursued individually by the universities and the Government, but there is need also for large-scale continuance of the cooperative effort that proved so fruitful in wartime. The universities have—and must have—the major share of scarce scientific manpower, the students essential to progress, and the tradition of fundamental research and education. The Commission has a nationwide program, and the tremendously expensive equipment that must be used. Obviously, both groups must be used if the program is to produce the greatest results.

The National Laboratory program was developed during 1947 to combine these sources of strength at the three laboratories, at Chicago, Oak Ridge, and Patchogue, Long Island.

*Argonne National Laboratory* is successor to the "Metallurgical Laboratory" at the University of Chicago, where the first nuclear reactor was built. It is still operated by the University; 29 midwest institutions are represented on the Council. Argonne is the center for the reactor development program. It has two operating reactors for the use of its 10 Divisions: Biology, Chemistry, Health Physics, Instrument Research and Development, Mass Spectroscopy and Crystal Structure, Medical, Metallurgy, Experimental Physics, Theore-

tical Physics, and Reactor Research and Development. The laboratory is to be consolidated at a single government site in DuPage County.

The *Clinton National Laboratory* at Oak Ridge has a great variety of specialized equipment and an experimental reactor. In addition to work in physics, metallurgy, and biology, the Laboratory serves as a center for the chemical and chemical engineering research, both basic and programmatic, with emphasis upon industrial applications. From this laboratory, the Isotopes Division distributes the isotopes produced in its reactor and in the electromagnetic separation plant at Oak Ridge.

Cooperating with the Clinton National Laboratory are 14 Southern universities, combined into the Oak Ridge Institute of Nuclear Studies. Its Graduate Training Program permits graduate students to complete their thesis research at Oak Ridge; during the 1947 fall semester, 198 students registered for courses in chemistry, chemical engineering, mathematics, physics, and zoology. A supplementary training program enables employees of the contractors to continue work while studying for their theses. The School of Nuclear Science of the Institute provides advanced study at the post-doctorate level in nuclear reactor development. The Research Participation program will make it possible for staff members of educational institutions to take part in the research programs of the contractors. The Institute will conduct a special School in Radioactive Tracer Techniques, beginning in the summer of 1948.

*Brookhaven National Laboratory* at Patchogue, Long Island, is operated by Associated Universities, Inc., and is being provided with equipment for advanced work in atomic energy, including a nuclear reactor and a number of accelerators. A staff of about 140 scientists was appointed to the Laboratory; about 180 consultants agreed to assist the work. Conferences on research subjects were attended during 1947 by close to 1000 scientists. Although Brookhaven awards no degrees or academic credits, graduate students are permitted to use its facilities.

## Public and Technical Information

The Commission established a Public and Technical Information Service to insure adequate control and dissemination of information. It combines five functions:

1. Preparation, reproduction, and controlled distribution within the project of classified reports.

2. Declassification by qualified reviewers of material which then becomes available for public use.

3. Editing, and reproduction of technical information material, including abstracts, reports, and declassified papers.

4. Security guidance service—aid to publishers, editors, reporters, broadcasters, leaders of citizen groups, or others issuing material relating to atomic energy — to prevent compromise of restricted data; and assistance to contractors and other agencies to safeguard restricted data.

5. Public information service — assisting representatives of the press, radio, trade organizations, and educational agencies, in obtaining declassified and unclassified data on atomic energy.

## Declassification of Documents

The declassification system developed under the Manhattan District during 1947 received 1200 documents for declassification. 120 scientists and engineers serving as reviewers recommended declassification of over 1000, after necessary changes and deletions. A number of these documents have been published in scientific and technical journals and made available through the Office of Technical Services of the Department of Commerce.

In order to insure uniform application of declassification policies and maintain maximum security of information, the Commission arranged a conference with representatives of the United Kingdom and of Canada in November 1947. Discussions were limited to technical data held jointly by the three nations as a result of their cooperation during the war. Canada and the United Kingdom now use the U. S. Declassification Guide made available to them in April of 1946.

## Technical Information

Congress recognized that "dissemination of scientific and technical information relating to atomic energy should be permitted and encouraged" as "essential to scientific progress." The system for providing such information was developed extensively during the year.

Of prime importance is the distribution of restricted data to those within the project who have need for, and are authorized to receive it. In 1947, an average of 50 copies each of 3,000 classified reports were distributed. Each laboratory received those categories of information it needed for its program. In addition to this routine distribution, 34,000 individual copies of such reports were distributed after careful screening to insure that no unnecessary dissemination of restricted information resulted.

To insure that project laboratories have all information in the field of atomic energy which originates outside the project, a Guide to Published Research in Atomic Energy and allied fields was prepared in the Technical Information Branch by assembling abstracts from the published abstract journals. During the year, 2,223 such abstracts were assembled and circulated.

To insure that project scientists have access to the information contained in the Research and Development Reports prepared at each laboratory, the Technical Information Branch prepares abstracts that can be circulated to all project laboratories; 507 such abstracts were prepared and issued during the year. This publication is classified Secret.

An extensive card index system for the 18,000 classified reports deposited in the Commission's libraries was developed by the Technical Information Branch; 906,000 index cards were prepared and distributed in the last year.

Nearly 162,000 copies of 1,700 declassified documents were distributed, including those declassified prior to January, 1947, to project laboratories, Government agencies, and 150 depositories of the Library of Congress, and made available to the public through the Office of Technical Services.

To make the information in these documents more readily accessible, 400 abstracts have been prepared for the same distribution as the documents themselves.

Progress was made toward completion of the National Nuclear Energy Series, a 110 volume compilation of research in the field of atomic energy conducted under Government auspices. Material for 6 volumes had been declassified and prepared for reproduction and public sale. Twenty classified volumes are ready for reproduction and distribution within the project. The Commission entered into a contract with Columbia University to handle the publication of the Series, and it is expected that a publisher will be announced shortly. The first issuance of the National Nuclear Energy Series will be known as the Manhattan Project Technical Section, covering work done under the Manhattan Project. Approximately half of the total number of volumes (approximately 25,000 pages) are expected to be declassifiable.

## Information for the Public

The media of public communication and information during 1947 continually devoted large amounts of space to reporting all that could be reported on the program. At the Commission's offices in Washington and the five Offices of Directed Operations, there was a mounting demand by reporters, editors, broadcasters, picture men, and leaders of citizen groups, for information from the Commission and for guidance on the security aspects of information obtained elsewhere.

To meet this demand the Commission authorized a small public information staff—four professional employees in Washington and one at each of the five Offices of Directed Operations. Through the declassification

system this staff obtained for all who asked such service, judgment on whether copy proposed for publication contained restricted data. It is evident that the communications media of the Nation desire overwhelmingly to avoid harm to the national defense and security through publication of restricted data.

An even larger volume of requests called for positive information. The Commission issued 75 statements for press and radio giving the facts about new developments in the atomic energy program.

It is the Commission's hope that the contractor organizations and the associated universities will redouble their efforts to provide speakers, visual materials, etc., to help satisfy public demand for information on atomic energy and the progress of its development.

The demand for both security guidance and positive information was indicated by the appointment by the American Society of Newspaper Editors of a Special Committee on Atomic Energy (Gideon Seymour, Minneapolis Star Journal, Chairman); the appointment of a Special Committee on Atomic Energy (Lloyd W. King, American Textbook Publishers Institute, Executive Secretary) by the American Textbook Publishers' Institute; and the appointment of a special committee by the Association of Secondary School Principals (P. E. Elicker, Washington, D. C., Executive Secretary) to develop a broad program for school and community education through a project called "Operation Atomic Vision."

## VIII: SECURITY

Soon after taking office, the Commission enlisted the services of Rear Admiral Sidney W. Souers, USNR, former Deputy Chief of Naval Intelligence and first head of the U. S. Central Intelligence Group, and of Frank J. Wilson, former Chief of the U. S. Secret Service, as special consultants. Meanwhile, the security system of the Manhattan Project remained in effect.

As a result of the study, the Commission established an Office of Security and Intelligence. The Office maintains liaison with the Central Intelligence Agency, the Federal Bureau of Investigation, and other security and intelligence agencies of the Government, as well as with the Congressional Joint Committee on Atomic Energy.

The new Office took many measures to insure the security control of plant, personnel, documents, and information. A five-member Personnel Security Review Board (Owen J. Roberts, formerly of the U. S. Supreme Court, Chairman) is being established, to make recommendations for definition of standards for employment by the Commission and its contractors.

Security staffs of the Managers of Directed Operations made 844 inspections and surveys during 1947. Mechanical safeguards were installed and, pending the completion of the construction program, an expanded guard force (3,100 men) was created.

A high level of personnel standards and indoctrination was set; at Los Alamos, out of 14,000 applicants for guard duty, only 1,000 were able to qualify. Emergency defense plans were made for all major facilities, in close liaison with the National Military Establishment.

A system was established to provide regular surveys. A Headquarters Inspection and Survey Unit was formed to advise the Commission and to assist the Managers of Directed Operations.

Access to restricted work is allowed to as few cleared construction workers as possible, classified work being started only after the non-classified construction has been completed.

A Classification and Document Control Board was set up to establish criteria for the classification of restricted data, to supervise accounting for classified documents, and to define information and activity which should be free from security restrictions.

There was no complete inventory of classified documents available when the program was transferred to Commission management. The inventorying was begun in July, 1947. In the highest category of classified data over 25,000 documents were identified. Over 450,000 technical and scientific reports are also in the process of inventory. Several million less highly classified papers must be scanned to separate these two groups of material. One location has more than 25,000 linear feet of files in which 20% of the material is classified.

At regular meetings security officers achieved the cooperation of plant and laboratory personnel in understanding and executing the requirements of security. Kits containing training material and copies of "Security Education Outline" were distributed.

Ten thousand copies of "Responsibility for Security" were also distributed, describing the obligations of all Commission and contractor personnel and the responsibilities of administrative officers.

## IX: ORGANIZATION AND ADMINISTRATION

A large amount of Commission and staff time has been devoted to the establishment of the basic structure of the organization. The military authorities were extremely helpful in facilitating the administrative transition to civilian operations. This work is now essentially complete.

### Policy Review and Formulation

The five-man Commission acts as a policy formulation body. The Commissioners meet with the Congressional Joint Committee on Atomic Energy, the General Advisory Committee, and the Military Liaison Committee. In addition, the Commission and the General Manager have sought the advice of several other groups on specific policy and administrative problems:

#### General Advisory Committee

The members of the General Advisory Committee (Dr. J. Robert Oppenheimer, Chairman) have made themselves available to the Commission in handling a wide range of scientific and technical matters. In addition to many meetings of subcommittees and special surveys by individual members, the full Committee met formally eight times for a total of 20 days.

The Committee has assisted in the solution of specific problems, and has provided a most helpful evaluation service in the reorientation of research and development programs. The committee has recommended specific projects and made suggestions to strengthen the program.

#### Joint Committee on Atomic Energy

The Joint Committee on Atomic Energy (Senator Bourke B. Hickenlooper, Iowa, Chairman) is the medium whereby the Commission reports fully on its activities including secret matters. The Joint Committee has assisted materially in reconciling the requirements of secrecy and necessary accountability of the Commission to the Congress.

Members of the Joint Committee and the Commission have had both formal and informal meetings. Representatives of the State Department and the National Military Establishment have participated in some of them. Members of the Joint Committee staff have visited the major installations of the Commission.

#### Military Liaison Committee

The Commission meets with the Military Liaison Committee (Lt. Gen. Lewis H. Brereton, U. S. Air Force, Chairman) on alternate Wednesdays and oftener when required. Working relationships were maintained with the armed services at various levels and were much broader than the activities involved in establishing and meeting military requirements.

The mutual interests extend to security of information and facilities, production, procurement, construction of facilities, biology and medicine, certain field operations, intelligence, support of basic research, appropriations and other fiscal matters, export controls, mobilization planning, participation of industry in the atomic energy program.

The small Washington office is a staff organization concerned with the development of programs and policies. The operations are carried on by private and governmental research, construction, and production contractors under the direction of five Offices of Directed Operations headed by Managers.

The Washington organization includes the four statutory program Divisions: Engineering, Military Appli-

cation, Production, and Research; two Divisions have been added and partially staffed: the Division of Biology and Medicine and the Division of Raw Materials. Directors of the six Divisions are empowered to advise Managers and contractors on the technical phases of their operations directly on behalf of the General Manager and the Commission. A program Council assures consideration of all aspects which require joint judgment of the Commission and staff.

Responsibility for the development of managerial policies, standards, and service rests with seven offices: Administrative Operations, Budgets, Comptroller, General Counsel, Organization and Personnel, Public and Technical Information Service, and Security and Intelligence.

Operating responsibility except in the field of raw materials is decentralized to the five offices of Directed Operations established at Chicago, Hanford, New York, Oak Ridge and Santa Fe (Los Alamos).

## Development of Program and Administrative Policy

The Commission and the General Manager have established a variety of temporary or permanent advisory bodies to examine operations and needs of the program.

### Advisory Committee for Biology and Medicine

The Commission established a permanent Advisory Committee for Biology and Medicine (Dr. Alan Gregg, Rockefeller Foundation, Chairman) on September 12, 1947, after its program and needs had been examined by a temporary Medical Board of Review. The permanent Committee is charged with the continuing study of the policies of the Commission in the medical, biological, and health physics aspects of the program.

### Advisory Committee for Exploration and Mining

The Advisory Committee for Exploration and Mining (Dr. Donald McLaughlin, Homestake Mining Co., Chairman) is charged with the responsibility of studying the Commission's present program and advising on questions of exploration and development.

### Patent Administration and Patent Advisory Panel

Under the Atomic Energy Act, patent rights will not be conferred to the extent that the inventions are used in the production of fissionable material or its utilization for a military weapon; at the same time, the Commission is authorized to make awards to such inventors. In addition, the Commission is authorized to declare a patent to be affected with the public interest and to license its use in the atomic energy program subject to a reasonable royalty fee.

A Patent Advisory Panel of five members submitted its initial report to the Commission in September, 1947. The Panel concluded that the impact of the Act upon the patent system and upon the normal process of industry had been made as small as possible and that the practice of the Commission in this field is to avoid unnecessary interference with the normal functioning of the patent system. The Panel found evidence of general satisfaction on the part of the Commission's contractors and was of the opinion that the patent clauses employed appeared to be generally satisfactory.

Following the submission of the report, the Panel undertook to consider regulations to govern proceedings before the Patent Compensation Board to be established under the Atomic Energy Act. Such regulations are expected to be ready in the near future.

By the end of 1947, there had been docketed more than 6500 records of inventions. Filing of a patent application was recommended in 2375 cases; over 11,500 project technical reports and 6600 notebooks have been examined for evidences of inventions.

### Industrial Advisory Group

More than 3000 contractors, subcontractors, and suppliers are taking part in the atomic energy program. Many more must be induced to participate. It is the policy of the Commission to move away from the present government monopoly as rapidly as feasible, having in mind the paramount consideration of the national security. The Industrial Advisory Group will explore opportunities for increased individual participation for profit and incentives for industry to get into the field. The objectives are to:

1. Utilize fully the Nation's industrial research and development capacity;

2. Keep the industries directly concerned fully informed as to the developments in their fields within security limitations;

3. Insure the opportunity for technical training in atomic energy of as large a part of American industry as possible.

An interim Industrial Advisory Group (S. J. Williams, Chairman) was appointed in October, 1947. The members, cleared for access to secret data necessary for their deliberations, visited all major Commission installations, consulted with present and potential AEC contractors, and started preparing their first report to the commission.

### Safety and Industrial Health Advisory Board

During the first ten months of 1947, 4.91 persons were injured among Commission and contractor personnel for each million man-hours worked, more than 50 per cent below the 1946 average for all industries.

In consultation with the National Safety Council, the Commission secured the services of a Safety and Industrial Health Advisory Board, which made an extensive survey of AEC and contractor practices.

### Advisory Board on Relations of the Atomic Energy Commission with Its Contractors

This temporary board (T. R. Looflerouw, Massachusetts Institute of Technology, Chairman) established in February, 1947, conducted an investigation of Commission-contractor relationships, particularly in the field of research, and made numerous suggestions for establishing more effective working relationships with the contractors.

### Committee on Scientific Personnel

Recognizing certain handicaps which derive from scientific inquiry in peacetime, the Commission established a Committee on Scientific Personnel to examine the problem. The Committee (Professor F. W. Loomis, University of Illinois, Chairman) reported in October, 1947. Recommendations were made with respect to: classification of employees; salaries; promotion and salary control; interchange of employees between institutions; tenure and retirement; consultant policies; vacations and sick leave; hazard pay and insurance; organization. These recommendations are now before the Commission.

## Administrative Developments

An analysis of obligations and expenditures for production, research, construction, town management, and administrative functions through November of 1947 has been completed.

Five of the Nation's leading public accounting firms were employed to review the accounting for five prime contracts, covering a cross section of Commission operations. Their reports are now being submitted.

## Personnel and Labor Relations

The Commission's policy of working through contractors and of decentralizing all supervision of contract operations is reflected in the distribution of personnel. There are approximately 500 employees in the Washington office, including the military personnel in the Division of Military Applications. Approximately 4800 employees are located in the operational centers. Approximately 55,000 persons are employed by contractors at AEC installations.

During the Commission's first year of operation, government employees

were decreased by 1100 while contractor employees increased by 14,000. The increase would have been greater if not offset by increased efficiency in certain operations, particularly at Oak Ridge.

The wartime arrangement with the National Labor Relations Board, whereby the Board will not certify labor organizations as representatives of employees of processing and research contractors other than at Oak Ridge, continues.

Requests for union recognition were renewed and new requests made during the period at Argonne National Laboratory and at Hanford. Action on these requests was deferred. A new agreement was entered into at Hanford between the construction contractor and the Building Trades Department of the AFL.

At Oak Ridge, another NLRB election was held at the Gaseous Diffusion Plant which was again won by the United Chemical Workers, CIO. Following the election, negotiations between the Carbide and Carbon Chemicals Corporation and the UCW resulted in a new 18 month contract effective December 10, 1947. A vote of the local union membership authorized the union to call a strike, but in view of agreement no strike resulted.

The Commission is working closely with the Joint Committee on Atomic Energy in considering how best to assure that work stoppages will not occur at AEC installations.

## Special Materials and Facilities

In November the Commission issued a regulation governing the export of facilities and equipment for the production of fissionable materials. In preparing for this action, the Commission solicited the advice of the manufacturers of the equipment to be controlled and made it clear that it will be the policy to interfere as little as possible in the conduct of normal business activities.

The regulation provided control over the export of (1) any facility capable of producing fissionable material (nuclear reactors, cyclotrons, or other particle accelerators); and (2) equipment suitable for service as component parts of a Class (1) facility; e.g., radiation detection equipment, mass spectrometers and component parts, high vacuum equipment.

Under the regulation, a specific license is required of persons intending to produce for export any such facilities, to transfer or acquire them for export, and to export them from the United States. Also incorporated is a general license for manufacture, production, transfer, and acquisition of such equipment within the United States.

Administration of the Commission's earlier regulation for the control of source materials has been assisted by the whole-hearted cooperation of industry. All essential industrial uses of uranium and thorium are being provided for.

# REPORT OF THE CONGRESSIONAL JOINT COMMITTEE

**On January 30 the Congressional Committee on Atomic Energy made its first report to Congress. Approximately two thirds of the report concerned the functions and organization of the Committee and the presidential appointments under the Atomic Energy Act. There followed some significant statements on Committee policy, excerpts from which follow:**

It is the considered conviction of the committee that, until such time as an effective, enforceable and reliable program for the international control of atomic energy is in successful operation, the most vital business of the Atomic Energy Commission must be the meeting of the atomic requirements of national defense.

The joint committee has been assured that those charged with these responsibilities are keenly aware thereof. This phase of the atomic energy program is of paramount and continuing interest to the joint committee and the committee considers that continuous knowledge and reassurance of the adequate discharge of these responsibilities is fundamentally necessary to its reliable evaluation of the general success of our program.

The joint committee is informing itself as completely as possible on all phases of the vital problem of maintaining security in the whole field of atomic energy. The scope and ramifications of the security responsibility which faces the Atomic Energy Commission are tremendous. Clearance for employment of thousands of persons, physical protection of numerous plants, adequate safeguarding of production, as well as accounting for and protection of millions of restricted documents, are major problems of the security program.

The joint committee has reviewed the investigative files of the Atomic Energy Commission relative to the employees of the Commission and its contractors. In a number of these cases reviewed, certain questions were raised by the committee and the matters were discussed in detail with the Atomic Energy Commission and its security staff. (In certain of these cases, the committee has requested that the Commission outline in detail its security policy as applied to these specific instances. In the majority of these cases, the personnel involved had been employed during the time when the project was operated by the Manhattan Engineer District.) The committee feels strongly that it must continue to follow closely, as it has in the past, the type of personnel engaged in the atomic energy program. To this end the committee staff will continue to conduct these studies of the personnel investigative files of the Atomic Energy Commission.

While recognizing that the Atomic Energy Commission is unique among Federal agencies, the committee, nevertheless, is aware of parallels, in many of the Commission's production activities, with major American industries such as petroleum refining, heavy chemical production, construction and power equipment manufacture. It is, therefore, the policy of the committee to apply certain criteria applicable to private industry as yardsticks in studying the operations of the Commission.

To this end, the joint committee has requested from the Atomic Energy Commission a statement of its major programs in terms of present accomplishment and long-range forecasts for future activities.

As a result of the threatened strike at Oak Ridge in November and December 1947 the joint committee has undertaken a thorough investigation of the important problem of a formula that will assure continuity of work in the atomic energy program. The committee is unanimous in its conviction that the national security demands uninterrupted operation of the critical facilities of the Atomic Energy Commission.

The committee has heretofore requested, and the request is in continuous effect, from the Atomic Energy Commission and from the Secretary of Defense, that any problems which they believe to exist or are reasonably foreseeable in the future, and which may require legislation or alteration of the act, be suggested to the committee from time to time for study and recommendation. At the time of filing this report, no such suggestions or recommendations have been received.

**The following amendment to the Atomic Energy Act of 1946 was approved by the Joint Committee on January 30.**

The Joint Committee on Atomic Energy, to whom was referred the bill (S. 1004) to amend the Atomic Energy Act of 1946 so as to provide that no person shall be appointed as a member of the Atomic Energy Commission or as a general manager of such Commission until an investigation with respect to the character, associations, and loyalty of such person shall have been made by the Federal Bureau of Investigation, having considered the same, report favorably thereon, with amendments, and recommend that the bill do pass.

**The committee made the following comment after passing the amendment:**

Your committee believes that a very grave responsibility rests upon members of the Atomic Energy Commission in the vital field of security as well as in the operation of existing facilities and in research and development. It would be wise, therefore, to apply to the members of the Commission and the general manager the same mandatory rule for investigation by the Federal Bureau of Investigation which is now applicable to employees of the Commission.